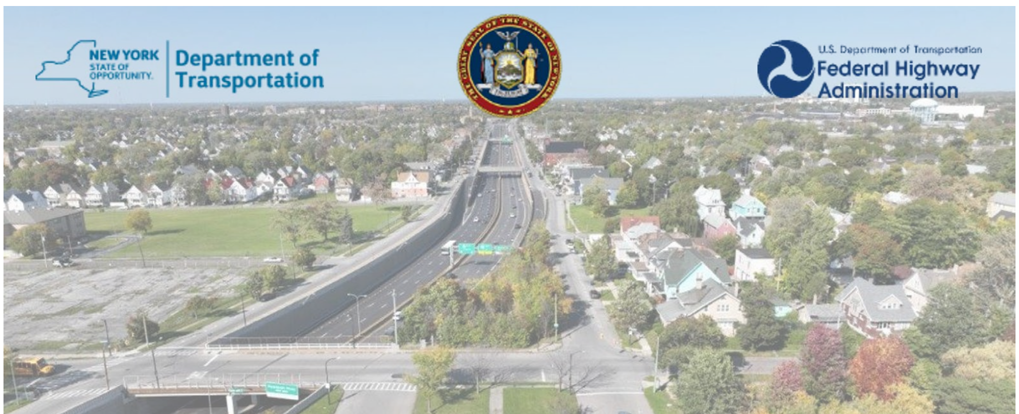
Appendix D9

Noise and Vibration Analyses Report

Noise and Vibration Analysis Report

NYS Route 33, Kensington Expressway Project
Project Identification Number (PIN): 5512.52

Kensington Expressway
City of Buffalo
Erie County, New York



PIN 5512.52
City of Buffalo, Erie County

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1 Introduction

This document describes the noise analysis that was conducted for the NYS Route 33, Kensington Expressway Project (hereafter, "the Project"). This document describes the proposed noise analysis methodologies and results for the Project for purposes of compliance with the FHWA traffic noise regulation (23 CFR 772), NYSDOT's Noise Analysis and Procedures ("Noise Policy"), the National Environmental Policy Act (NEPA), and the State Environmental Quality Review Act (SEQRA).

1.1 Project Overview

The Project is located in the City of Buffalo, Erie County, New York. The purpose of the Project is to reconnect the community surrounding the defined transportation corridor and improve the compatibility of the corridor with the adjacent land uses, while addressing the geometric, infrastructure, and multi-modal needs within the corridor in its current location. The transportation corridor is defined as NYS Route 33 (Kensington Expressway) and Humboldt Parkway between Best Street and Sidney Street.

The following objectives have been established to further refine the Project purpose:

- Reconnect the surrounding community by creating continuous greenspace to enhance the visual and aesthetic environment of the transportation corridor;
- Maintain the vehicular capacity of the existing transportation corridor;
- Improve vehicular, pedestrian, and bicycle mobility and access in the surrounding community by implementing Complete Street roadway design features; and
- Address identified geometric and infrastructure deficiencies within the transportation corridor.

The Build Alternative does not involve changes to the capacity of NYS Route 33 through the transportation corridor and therefore is not expected to substantially alter regional traffic patterns. The Build Alternative does include the elimination of a partial interchange between NYS Route 33 and East Utica Street, which may shift some local traffic within the transportation corridor to use the nearby Best Street interchange instead. Existing local street connections across NYS Route 33 would be maintained under the Build Alternative and new east-west street connections would be created on top of the tunnel. A preliminary traffic study was completed as documented in the Project Scoping Report and additional traffic analyses have been performed subsequently as documented in Chapter 3 and Appendix B of this DDR/EA.

1.1.1 Local Street Improvements

Subsequent to the publication of the PSR, the Build Alternative was expanded to include enhancements to local streets between Wohlers Avenue to the west and Fillmore Avenue to the east. This work would include resurfacing of the existing pavement, provision of curb ramps, curb bump outs for traffic calming, landscaping and related Complete Streets improvements. The local street improvements would not include substantial horizontal or vertical alignment changes.

1.2 Characteristics of Noise

Noise is generally defined as unwanted sound. The level of noise perceived at a receiver depends on numerous variables, including the noise level at the source, the distance from the noise source to the receiver, physical barriers that may attenuate or block the noise reaching the receiver, and the sensitivity of the receiver.

The following three physical characteristics of noise have been identified as being important to the determination of noise acceptance: (1) intensity; (2) frequency; and (3) the time-varying nature of the noise.

Intensity is a measure of the magnitude or energy of the sound and is directly related to the sound pressure level. Sound pressure levels are expressed in terms of a logarithmic scale, with units called decibels (dB) that correspond to the way that the human ear senses noise. As the intensity of a noise increases, it is judged to be more annoying or less acceptable.

Frequency is a measure of the total qualities of sound. People are most sensitive to sounds in the middle to high frequencies; therefore, higher frequencies cause more annoyance. This sensitivity has led to the use of the A-weighted sound level, which weights different frequencies on a spectrum in a manner similar to the sensitivity of the human ear. Thus, the A-weighted sound level in decibels (dB(A)) provides a simple measure of intensity and frequency that correlates well with human hearing. Common noise levels are shown in **Table 1**.

Environmental noise is rarely constant with time. It is necessary to use a method of measure that will account for the time-varying nature of noise. The equivalent sound pressure level (Leq) is defined as the continuous steady sound level that would have the same total A-weighted sound energy as the real fluctuating sound measured over the same period of time. Leq is typically used for highway noise analysis. This unit of measure, therefore, is used in the traffic and construction noise analyses performed for this Project.

Table 1
Common Noise Levels

Sound Source	(dB(A))
Military jet, air raid siren	130
Amplified rock music	110
Jet takeoff at 500 meters	100
Freight train at 30 meters	95
Train horn at 30 meters	90
Heavy truck at 15 meters	80–90
Busy city street, loud shout	80
Busy traffic intersection	70–80
Highway traffic at 15 meters, train	70
Predominantly industrial area	60
Light car traffic at 15 meters, city or commercial areas, or residential areas close to industry	50–60
Background noise in an office	50
Suburban areas with medium-density transportation	40–50
Public library	40
Soft whisper at 5 meters	30
Threshold of hearing	0

Note: A 10 dB(A) increase in level appears to double the loudness, and a 10 dB(A) decrease halves the apparent loudness.

Sources:

Cowan, James P. Handbook of Environmental Acoustics, Van Nostrand Reinhold, New York, 1994. Egan, M. David, Architectural Acoustics. McGraw-Hill Book Company, 1988.

1.3 Regulatory Framework

The project does not meet the definition of a Type I Project per 23 CFR 772.5. Although the project does involve the physical alteration of a highway, it will not involve substantial alterations that will decrease the distance between a traffic noise source and the closest receptor. The major source of traffic noise within the general study area is NYS Route 33 (Kensington Expressway), which is a high volume (approximately 75,000 vpd -existing AADT) and high speed (55 mph) freeway. The horizontal alignment of the Kensington Expressway will not be changed by the project. The project proposes to cap 4,150 feet of the Kensington Expressway, blocking the line-of-sight between the traffic noise source and receptors along this length. The project proposes to lower the vertical alignment of the Kensington Expressway, thus increasing the shielding (via tunnel portal retaining walls) between the traffic noise source and receptors. Therefore, there will be no substantial alterations of the Kensington Expressway horizontal or vertical alignment, as defined by 23 CFR 772.5. The Humboldt Parkway, which is a low volume (approximately 9,500 vpd -existing AADT) and low speed (30 mph) roadway, is not a major source of traffic noise within the general study area. The vertical alignment of the Humboldt Parkway will not be changed by the project. The project proposes to shift the Humboldt Parkway inward and further away from receptors; therefore, there will be no substantial alterations to the Humboldt Parkway horizontal and vertical alignment, as defined by 23 CFR 772.5.

Therefore, a traffic noise analysis is not required for this Project under 23 CFR 772. However, for NEPA and SEQRA purposes, a traffic noise analysis was performed for the No Build and Build condition(s).

Predicted noise levels were used in the NEPA/SEQRA analysis to assess anticipated noise level changes between the No Build Alternative and the Build Alternative (ETC+20). In accordance with FHWA's "Highway Traffic Noise Analysis and Abatement Policy and Guidance," a noise level change of 3 dB(A) or less is generally imperceptible to the human ear. Therefore, an increase of over 3 dB(A) from the No Build Alternative to the Build Alternative at a noise sensitive receiver was used to assist in identifying receivers that would experience perceptible noise increases from the Build Alternative. Any perceptible increases in traffic noise would warrant further investigation to determine if these increases would affect the quality of the human environment, thus warranting mitigation.. The FHWA Noise Abatement Criteria (NAC) in 23 CFR Part 772 or substantial increases (by 6 dB(A) or more) was not used to identify noise impacts or indicate the requirement for an abatement analysis under 23 CFR 772 and the NYSDOT Noise Policy.

1.3.1 Local Noise Code

The City of Buffalo's noise ordinance restricts construction work (including building, excavating, hoisting, grading, and pneumatic hammering) between the hours of 9:00 PM and 7:00 AM that would cause "sound which annoys or disturbs a reasonable person of normal sensitivities in a residential real property zone."[1] Although NYSDOT is not subject to local noise ordinances, the contractor would implement reasonable efforts to accommodate the intent of the local ordinance to the extent practicable.

2 Study Area

As stated in FHWA's Highway Traffic Noise: Analysis and Abatement Guidance, "Highway traffic noise is not usually a serious problem for people who live more than 500 feet from heavily traveled freeways or more than 100 to 200 feet from lightly traveled roads." Thus, the detailed traffic noise modeling effort for this Project is focused on the area within 500 feet of the limits of work surrounding the NYS Route 33 and Humboldt Parkway corridor (**Figure 1**). This traffic noise study area encompasses the areas where there is the potential for traffic noise changes due to tunnel construction and alignment changes to local streets.

3 Existing Conditions Noise Monitoring

Noise measurements have been taken at four (4) locations along the project corridor. These measurements consisted of one (1) 24-hour noise measurement and three (3) 15-minute Leq noise measurements. Monitoring locations are shown in **Figure 1**.

The 24-hour noise measurement was taken at measurement location #3 to determine the peak AM and peak PM noise hours. The 24-hour measurement was obtained between 1:00 PM on Wednesday, October 27th, 2021, and 1:00 PM on Thursday, October 28th, 2021. The temperature was between 58 – 69 degrees

[1] https://ecode360.com/11767329

Fahrenheit, with relative humidity between 35 – 51% and the wind between 0 – 6 mph. The 24-hour monitoring results are summarized in **Table 2**. Based on the 24-hour measurement obtained at location #3, the peak noise AM traffic time period is between 7:00 AM – 9:00 AM and the peak noise PM traffic time period is between 3:00 PM – 5:00 PM. This directly correlates with the AM and PM Peak Noise Periods. The Peak Noise Hour, or loudest noise hour, is between 8:00 AM – 9:00 AM.

Table 2

24-Hour Noise Monitoring Summary

Date	10/27/2021 through 10/28/2021						
Location	Kensington Expressway Noise Study (24 Hr.)						
Temp (F)	58/69						
Humidity (%)	35/51						
Wind (mph)	0-6						
Time	Leq (hourly)	Lmax	Lmin	Time	Leq (hourly)	Lmax	Lmin
1:00 PM	68.2	92.3	60.5	1:00 AM	59.4	71.7	42.4
2:00 PM	68.8	92.2	60.3	2:00 AM	59.3	92.0	42.3
3:00 PM	69.6	92.2	63.6	3:00 AM	59.7	86.7	41.0
4:00 PM	69.6	91.3	64.7	4:00 AM	58.8	69.7	41.2
5:00 PM	69.6	85.3	63.1	5:00 AM	63.4	76.4	45.2
6:00 PM	68.6	90.3	60.8	6:00 AM	67.2	77.1	52.6
7:00 PM	67.4	85.0	58.5	7:00 AM	69.4	77.1	57.1
8:00 PM	67.5	90.5	56.3	8:00 AM	70.1	80.6	62.7
9:00 PM	66.2	89.2	55.8	9:00 AM	68.7	85.2	61.2
10:00 PM	66.2	87.0	50.7	10:00 AM	67.9	84.6	59.3
11:00 PM	64.1	76.9	49.5	11:00 AM	67.2	83.7	60.5
12:00 AM	62.3	85.8	46.6	12:00 PM	67.7	87.6	59.2

The remaining 15-minute Leq noise measurements at locations #1, #2 and #4 were conducted during the peak noise periods identified through the 24-hour monitoring. Traffic volumes on the adjacent and adjoining surface roads in proximity of the measurement locations were recorded during the 15-minute noise measurements. The short-term monitoring results are summarized in **Table 3**.

Table 3

Short-Term Noise Measurements Summary

Measurement Location	AM Peak Noise Level (dBA)	PM Peak Noise Level (dBA)	Worst Case (AM or PM) Noise Level (DBA)
#1	69	68	69
#2	72	72	72
#3	70	69	70
#4	72	72	72

Note, all noise levels are truncated to a whole number.

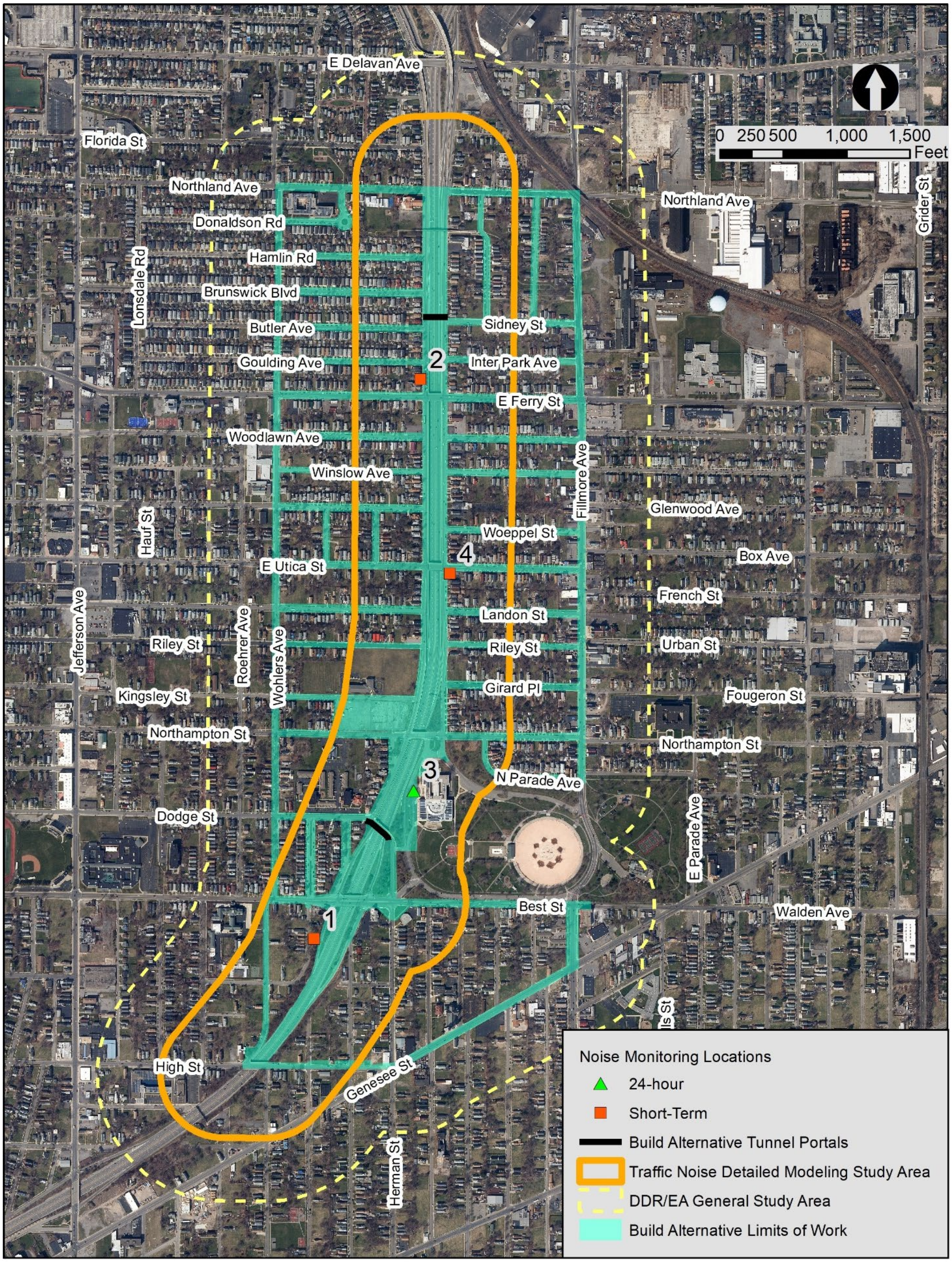

Figure 1 Traffic Noise Study Area and Noise Monitoring Locations

4 Operational Traffic Noise Modeling

The traffic noise analyses was performed using the FHWA Traffic Noise Model (TNM) version 3.1. The modeling methodology followed the procedures in the NYSDOT Noise Policy.

4.1 Noise Model Validation

For the validation modeling, noise models (reflecting site-specific conditions, geometry, traffic volumes, vehicle distributions, and speeds observed during the field noise measurements) were developed for each short-term field measurement receiver site. The calculated noise levels from the validation modeling were compared with the field measured noise levels below in **Table 4**. The Project's noise model is considered valid if the modeled existing noise levels are within 3 dB(A) of the measured noise levels. Since the modeled existing noise levels are all within 3 dB(A) of the measured noise levels, the results of the noise model validation indicate that the traffic noise model can be used for noise prediction in this area.

Table 4
Noise Model Validation Summary

Measurement Location	AM Peak Noise Level Field Measured (dBA)	TNM Validation Noise Level Modeled (dBA)	Difference Between Measured and Modeled (DBA)
#1	69	68	1
#2	72	71	1
#3	NA*	NA*	NA*
#4	72	70	2

Note, all noise levels are truncated to a whole number.
*Measurement location 3 is a 24-hour measurement location; therefore, it was not included in the model validation.

4.2 Analysis Conditions

The design year for this Project is 2047 (ETC+20). The following analysis conditions were modeled in the traffic noise analysis:

- No Build Alternative (2047)
- Build Alternative (2047)

4.3 Noise Sensitive Areas and Receivers

Existing sensitive receivers within the traffic noise study area (including residences, parkland, schools, and places of worship) were identified under this Project. Land use categories for use in this noise study are presented in **Table 5**. The potentially affected areas within the study area were first identified and categorized by Land Use Category (see **Figure 2** in **Attachment A**).

Table 5
Noise Study Land Use Categories

Land Use Category	Interior or Exterior	Land Use Description
A	Exterior	Lands on which serenity and quiet are of extraordinary significance and serve an important public need, and where the preservation of those qualities is essential if the area is to continue to serve its intended purpose.
B[1]	Exterior	Residential
C[1]	Exterior	Active sport areas, amphitheaters, auditoriums, campgrounds, cemeteries, day care centers, hospitals, libraries, medical facilities, parks, picnic areas, places of worship, playgrounds, public meeting rooms, public or nonprofit institutional structures, radio studios, recording studios, recreation areas, Section 4(f) sites, schools, television studios, trails, and trail crossings.
D	Interior	Auditoriums, day care centers, hospitals, libraries, medical facilities, places of worship, public meeting rooms, public or nonprofit institutional structures, radio studios, recording studios, schools, and television studios.
E[1]	Exterior	Hotels, motels, offices, restaurants/bars and other developed lands, properties or activities not included in A-D or F.
F	Either	Agriculture, airports, bus yards, emergency services, industrial, logging, maintenance facilities, manufacturing, mining, rail yards, retail facilities, shipyards, utilities (water resources, water treatment, electrical), and warehousing.
G	Either	Undeveloped lands that are not permitted.

Notes:
1. Includes undeveloped lands permitted for this Activity Category.

Representative noise receivers within the traffic noise study area were chosen as modeling locations. Receiver modeling locations were chosen based on common noise environments. Each modeled receiver represented multiple receptors/locations with similar source-receptor distances and imperceptible differences in noise levels. A noise receiver is defined as a point where highway traffic noise levels are measured and/or modeled. A noise receptor is defined as a discrete or representative location of a noise sensitive area(s) for any of the Noise Land Use Categories listed in **Table 5**. An individual noise receiver may represent multiple receptors. Assignment of receptors per receiver assumed the following:

- Each single-family residence was counted as one receptor.
- Each residence in an multifamily dwelling was counted as one receptor.
- For hotels and motels that primarily provide long-term accommodations (i.e., one month or more per stay), each suite/unit was counted as one receptor.
- For parks, cemeteries, or other open lands in Noise Study Category C, the receptor assignment was based on the average lot size for the area. The procedure is as follows: Based on the local municipal zoning ordinance(s), determine the average minimum lot size for residential zoning districts near the project area. If a facility has more than one affected exterior area of frequent human use, add the amounts of affected land area together. Divide the total affected land area by the average residential lot size to calculate an equivalent number of residential receptors. Round the number of receptors up to a whole number to obtain the number of receptors within the facility.

In total, 199 representative noise receivers were chosen to represent noise receptors along the Kensington Expressway. Receivers were placed in exterior areas of frequent human use. Traffic noise modeling was performed at these locations to predict future noise levels for the No Build and Build Alternatives. Refer to **Figures 3A through 3J** for the receiver locations.

Five of the 199 receivers were modeled within the proposed new greenspace above the tunnel deck to document the anticipated Build Alternative noise levels in the noise sensitive areas created by the Project. These receivers were not compared to No Build Alternative levels because the greenspace would not exist under the No Build Alternative.

The remaining 194 of the 199 receivers represented 770 receptors along the corridor. These receivers were used for comparison purposes to identify predicted changes in noise levels expected from the Build Alternative.

4.3.1 Noise Sensitive Areas Created by the Project

As indicated above, representative receivers were modeled within the new greenspace on the tunnel deck to document the anticipated Build Alternative noise levels in the noise sensitive areas created by the Project. These noise levels were modeled for NEPA/SEQRA and decision-making purposes. These receivers were not compared to No Build Alternative levels because these areas are within the actual roadway under the No Build Alternative.

4.4 Roadways and Traffic Data

The traffic data collected during the 2021 field noise measurements were used to validate the model.

Traffic volumes, speeds, and classifications for future No Build Alternative and future Build Alternative were obtained for the peak noise hour (i.e., 8:00 AM – 9:00 AM) from the Project's traffic modeling effort.

4.5 Elevation Data Sources

Ground level elevations and structure elevations (e.g., bridges, buildings, walls) used within the noise models were obtained from CADD survey data when available; otherwise, elevations were estimated from Google Earth elevations, County contour maps, or United States Geological Survey (USGS) maps.

4.6 Existing Noise Barriers and Retaining Walls

The existing retaining walls and elevation changes throughout the corridor can act as noise barriers. Applicable structures and landforms were included within the No-Build Alternative noise model.

4.7 Terrain Lines

Terrain lines show the location of surrounding terrain and the horizontal and vertical attributes of the terrain. Terrain lines are used to show where specific areas may be of a certain height or length that they provide barriers or cause an increase in traffic noise levels. Terrain lines were used in the TNM model to define the elevation changes in areas without roadways or other TNM elements that define the ground elevation.

4.8 Building Rows

Building rows consist of rows of buildings between roadways and receivers that act like barriers to reduce noise levels. Building rows that have gaps allow noise levels to travel through these gaps. Building rows provide sound dampening but at a decreased level due to these gaps. Building rows were used in the TNM model to represent applicable residential and commercial structures throughout the neighborhood.

4.9 Tree Zones and Ground Zones

When calculating traffic noise, tree zones were added to the model at specific locations. Tree zones are made up of heavy wooded areas and thick undergrowth located between the roadway and the receiver and provide a noise reduction. Given the urban nature of the study area, the need for modeling tree zones was limited.

Ground zones were used to define the type of ground located in the area of interest. The ground type of an area has varying acoustical attenuation characteristics that are used when calculating traffic noise levels. For example, a grass covered area provides more sound dampening than a paved area. Ground zones were used throughout the corridor to define applicable areas that were not already defined by other TNM elements.

4.10 Tunnel Portals

At the proposed tunnel portals, there is a potential for increased traffic noise because of the hard sound reflective surfaces of tunnel portals that would amplify the traffic noise. Noise levels projecting from each end of the tunnel is referred to as "portal noise" (Tunnel Portal Noise, TRP 1058, Jim O'Connor). The tunnel portal noise levels were accounted for in the traffic noise analysis using the precalculated adjustments documented in Table 15 of NCHRP Report 791, Supplemental Guidance on the Application of FHWA's Traffic Noise Model (TNM), Chapter 13: Tunnel Openings. The NCHRP Report 791 tunnel effect adjustments were added to the TNM-calculated noise levels due to roads outside the tunnel at each affected receiver to determine the anticipated noise levels for the portal areas.

In addition, given the planned depth as the roadways enter the tunnel (approximately 25-30 feet), the grade of the roadway would be below the surrounding street level to an extent that would require retaining walls. It is anticipated that the retaining walls and reduction in grade would reduce the line-of-sight to nearby receivers and act as noise walls. This would tend to reduce reflective noise from the tunnel portals and overall traffic noise for nearby receivers. The TNM model for this Project has accounted for the retaining walls and reduction in grade.

4.11 Noise from Air Intakes

The Build Alternative tunnel design would not include vertical air intake structures along the capped section of the Kensington Expressway that could provide a pathway for traffic noise to reach publicly accessible greenspace. Fresh air intake will be through the tunnel portals.

4.12 Ventilation Fan Noise

Noise related to the operation of ventilation fans is not expected to create an effect to noise receivers along the corridor. Mechanical ventilation systems would not be used under normal operating conditions. Ventilation jet fans would only be used if there was a breakdown in traffic flow (congested traffic idling in the tunnel for an extended period), during monthly testing (short-duration test) or during a fire incident. During monthly testing, not all the fans would be used at full speed simultaneously so that traffic-related noise from the tunnel portals and the local streets would be the predominate noise source. To limit the noise in the tunnel during an incident (to enable communication), jet fans would be equipped with sound attenuators, so that the sound pressure level inside the tunnel when all fans are in operation at full speed would not exceed 85 dBA (specified e.g. in NFPA 502).[2]

4.13 Traffic Noise Results and Comparison

Predicted future noise levels for the No-Build Alternative were compared to the Build Alternative to identify the locations where a perceptible change in noise levels is predicted.

In accordance with FHWA's "Highway Traffic Noise Analysis and Abatement Policy and Guidance," a noise level change of 3 dB(A) or less is generally imperceptible to the human ear; therefore, a comparison was made to determine the number of receivers with changes of more than 3 dB(A) as compared to the No Build Alternative conditions. See the **Table: Noise Summary - Model Results** in **Attachment C** for the results of the analyses. Also, see **Figures 3A through 3J** in **Attachment B** for the results of the analyses by location. Perceptible noise level changes are summarized in **Table 6**, below, by Land Use Category. Modeling input and output files are available upon request.

4.13.1 No Build Alternative

Under the No Build Alternative, the existing roadways would remain with ongoing needed maintenance and repairs (see **Section 3.2.1** of the DDR/EA). No new roadways or associated supporting infrastructure related to this Project would be constructed, and changes in future traffic noise levels within the transportation corridor would be associated with normal changes in traffic and/or projects independent of this Project (i.e., those that would occur without the Project).

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[2] National Fire Protection Association. Standard for Road Tunnels, Bridges, and Other Limited Access Highways

No Build conditions were modeled for the year 2047 (ETC +20) in order to provide a baseline for comparison to the predicted noise levels under the Build Alternative in 2047.

Under the No Build Alternative, noise levels within the traffic noise study area would range from 45 to 74 dB(A). Areas closer to the Kensington Expressway (i.e., along Humboldt Parkway) would generally experience higher noise levels (ranging from 62 to 74 dB(A)) than areas further from the Kensington Expressway along local streets. The wide range in noise levels along Humboldt Parkway is mainly associated with the depressed nature of portions of the Kensington Expressway and the noise attenuation provided by the break in line-of-sight due to the retaining walls. Proximity to cross streets also influences noise levels to a lesser degree. The noise levels along Humboldt Parkway near the depressed expressway segment would range from 62 to 65 dB(A), while the noise levels along Humboldt Parkway near the at-grade expressway segments would range from 70 to 74 dB(A).

4.13.2 Build Alternative Effects

Under the Build Alternative, noise levels within the traffic noise study area would range from 44 to 75 dB(A). The predicted future noise levels for the Build Alternative were compared to those for the No Build Alternative at each receiver to identify the locations where a perceptible change in noise levels is predicted. Most of the differences in noise levels appear to be related to the covering of the Kensington Expressway; however, some of the differences in noise levels would also associate to changes in travel patterns related to the Build Alternative design.

As stated above, a noise level change of 3 dB(A) or less is generally imperceptible to the human ear; therefore, a comparison was made to determine the number of receivers with changes of more than 3 dB(A), as compared to the future No Build Alternative conditions. Perceptible noise level changes are summarized in **Table 6** by Noise Study Land Use Category.

Compared to the No Build Alternative conditions, it is anticipated that traffic noise level increases would not be perceptible at any of the modeled locations and decreases in traffic noise would be perceptible at 70 receivers, representing 271 receptors.

The majority of receivers with a perceptible noise level decrease are located adjacent to the proposed tunnel section where Kensington Expressway traffic would be isolated from adjacent receptors by the tunnel cap. Perceptible noise level reductions due to the proposed tunnel are expected to be in the range of 4 to 13 dB(A).

Tunnel portal effect adjustments were assessed, in accordance with NCHRP Report 791, for receivers within 500 feet of the tunnel portals; however, only 2 of the receivers required numeric adjustments of +1 dB(A) (673 Humboldt Pkwy and 51 Linden Park). The remaining assessed receivers had fractional adjustments that did not affect the truncated whole number results. In general, the increase in noise levels due to the tunnel portal adjustments was offset by the decrease in noise due to the partial isolation from traffic noise from the tunnel cap and the required lower profile of the roadway. Both of the adjusted receivers still showed perceptible decreases in noise levels for the Build condition even with the +1 dB(A) adjustment in Build Alternative noise levels.

Table 6
Receptors with Perceptible Noise Level Changes (i.e., >3 dBA) by Land Use Category

Land Use Category	Perceptible Increases From 2047 No Build Alternative to 2047 Build Alternative *	Perceptible Decreases From 2047 No Build Alternative to 2047 Build Alternative *
B – Residential	None	248
C – Park	None	9
C – School	None	3
C – Medical Facility	None	2
C – Place of Worship	None	9
TOTALS	None	271

Note: *Predicted future noise level changes due to the Build Alternative are in relation to the No Build Alternative noise analysis results.
Only categories with perceptible noise level changes are shown.

As indicated above, noise levels were also modeled for the future Build Alternative conditions at five locations along the proposed greenspace above the tunnel. Noise levels within the proposed greenspace would range from 57 dB(A) to 63 dB(A). Noise levels at these receivers were not compared to No Build Alternative noise levels because the space would not exist under the No Build Alternative.

4.13.3 Traffic Noise Abatement

No perceptible traffic noise level increases are predicted under the Build Alternative; therefore, the Build Alternative is not anticipated to result in changes to the human environment that would warrant mitigation.

4.14 Information for Noise-Compatible Land Use Planning

Noise-compatible land use planning can help to minimize future traffic noise impacts in the vicinity of highway projects. The effective implementation of noise-compatible planning measures is a shared responsibility between NYSDOT (who analyzes highway noise impacts) and local governments (who regulate land uses). As such, outreach to local government officials is an important part of NYSDOT's Noise Policy. Outreach will be made to local government officials in accordance with requirements of the NYSDOT Noise Policy. This Noise and Vibration Analysis Report will be provided to local government officials for reference.

5 Construction Noise

Construction noise differs from traffic noise in the following ways:

- Construction noise lasts only for the duration of the construction contract;

- Construction activities are generally short term;
- Construction activities are usually limited to the daytime hours when most human activity takes place; and
- Construction noise is intermittent and depends on the type of operation.

Construction activities associated with the Build Alternative would include demolition, excavation, rock-blasting, sub-base preparation, roadway/bridge/tunnel construction, and other miscellaneous work. The levels of noise would vary, depending on the construction activities undertaken and the anticipated duration of the construction. The parameters that determine the nature and magnitude of construction noise include the type, age, and condition of construction equipment; operation cycles; the number of pieces of construction equipment operating simultaneously; and the distance between the construction activities and receivers. Temporary construction noise from these activities and equipment could affect nearby receivers. Many of these parameters would not be fully defined until final design plans and specifications have been prepared and, in some cases, until the contractor has been selected; however, representative construction scenarios based on typical construction procedures have been identified for the Project and were used to assess potential effects.

Land uses and activities along the corridor that may be affected by noise from construction of the project consist of residential, places of worship, parks, medical facilities, playgrounds, sports facilities, and educational facilities. The frequency of use for each of these land uses and activities is considered year-round even though the parks, playgrounds, and sports facilities would likely have less use in the winter.

To evaluate potential noise levels as a result of construction of the Build Alternative, the Roadway Construction Noise Model (RCNM) version 1.1, developed by the Federal Highway Administration (FHWA), was employed. No version of RCNM is required to be used on Federal-aid projects; however, this model is a screening tool that can be used for the prediction of construction noise during the various stages of project development and construction. The anticipated types of construction equipment and distances to the center of the construction area were entered into the RCNM. The construction noise analysis was performed in iterations to predict noise levels for nine of the loudest construction scenarios during construction of the Build Alternative, at six representative distances (50, 100, 150, 200, 250, and 300 feet) from the construction zones, under both depressed roadway conditions and at-grade roadway conditions. These model iterations allow for estimation of noise levels along the length of the corridor at different distances for each construction scenario. The nine modeled construction scenarios and anticipated equipment are listed below. Refer to **Figures 4a through 4b** in **Attachment D** for the locations of the nine construction scenarios. Reference noise levels for each piece of construction equipment listed below are provided in **Table 7**.

1. Construct Support-of-Excavation (SOE) Walls Behind Existing Retaining Walls
    - 2 - Drill Rig Trucks – to install soldier piles
    - 2 - Auger Drill Rigs – to install soldier piles
    - 2 - Concrete Mixer Trucks – to deliver concrete to socket soldier piles
    - 2 - Excavators – to remove drilling spoils
    - 2 - Dump Trucks – to remove drilling spoils
    - 3 - Pickup Trucks – transportation for labor staff

- 1 - Generator – to provide electricity on-site
- 1 - Compressor (air) – to provide compressed air for tools
- 1 - Vibratory Pile Driver – to drive piles

2. Removal of Existing Retaining Walls

- 2 - Excavators – to remove concrete debris and soil resulting from retaining wall removal and install lagging for SOE walls
- 2 - Mounted Impact Hammers (hoe ram) – to break-up the concrete of the walls
- 2 - Front End Loaders – to remove concrete and soil resulting from retaining wall removal
- 2 - Dump Trucks – to remove concrete and soil resulting from retaining wall removal
- 1 - Auger Drill Rig – for SOE wall tiebacks
- 3 - Pickup Trucks – transportation for labor staff
- 1 - Generator – to provide electricity on-site
- 1 - Compressor (air) – to provide compressed air for tools
- 1 - Concrete Saw – may be required for detailed or confined concrete removal areas
- 1 - Welder / Torch – to cut concrete reinforcing during concrete removal
- 2 - Jackhammers – for miscellaneous concrete removal where hoe-rams cannot be used
- 1 - Pneumatic Tool – for installation of lagging and tiebacks for soldier-pile and lagging walls

3. Eastbound Construction of Retaining Walls and Tunnel Walls

- 2 - Drill Rig Trucks – to install secant wall
- 2 - Auger Drill Rigs – to install secant wall
- 1 - Crane – to install secant wall reinforcing
- 2 - Concrete Mixer Trucks – to deliver concrete for installation of secant wall
- 2 - Excavators – to remove drilling spoils
- 2 - Dump Trucks – to remove drilling spoils
- 3 - Pickup Trucks – transportation for labor staff
- 1 - Generator – to provide electricity on-site

4. Bridge Demolition (Removal)

- 2 - Excavators – to break up or lift out deck
- 2 - Mounted Impact Hammers (hoe ram) – to break up deck
- 1 - Front End Loader – to remove concrete debris
- 2 - Dump Trucks – to remove concrete debris
- 1 - Crane – to lift out steel girders
- 3 - Pickup Trucks – transportation for labor staff

- 1 - Generator – to provide electricity on-site
- 1 - Concrete Saw – to sawcut deck into panels for removal
- 1 - Compressor (air) - to provide compressed air for tools
- 2 - Jackhammers – for miscellaneous demolition not possible for large equipment
- 2 - Pneumatic Tools – various air tools for bridge demolition
- 1 - Manlift – to assist in steel girder removal
- 1 - Welder / Torch – to cut concrete reinforcing during concrete removal and to assist in steel girder removal

5. Center Tunnel Wall Construction

- 2 - Mounted Impact Hammers (hoe ram) – to remove median barrier and bridge piers (as necessary)
- 2 - Excavators – to remove overburden at median and to remove drilling spoils
- 2 - Drill Rig Trucks – to install secant wall
- 2 - Auger Drill Rigs – to install secant wall
- 1 - Crane – to install secant wall reinforcing
- 2 - Concrete Mixer Trucks – to deliver concrete for installation of secant wall
- 2 - Dump Trucks – to remove concrete debris, overburden and drilling spoils
- 3 - Pickup Trucks – transportation for labor staff
- 1 - Generator – to provide electricity on-site

6. Soil Overburden Removal

- 2 - Mounted Impact Hammers (hoe ram) – to break up concrete pavement
- 3 - Excavators – to excavate soil overburden
- 2 - Dozers – to grade and push overburden for removal
- 3 - Front End Loaders – to load overburden on to trucks
- 3 - Dump Trucks – to remove overburden from site
- 3 - Pickup Trucks – transportation for labor staff

7. Rock Removal - Mechanical Means

- 2 - Excavators – to remove the rock debris
- 2 - Mounted Impact Hammers (hoe ram) – to break up rock
- 2 - Front End Loaders – to load rock debris on to trucks
- 2 - Dump Trucks – to remove rock debris from site
- 2 - Pickup Trucks – transportation for labor staff
- 1 - Generator – to provide electricity on-site
- 2 - Pneumatic Tool – various air tools for rock removal

- 2 - Compressors (air) - to provide compressed air for tools
- 1 - Concrete Saw – to assist in rock removal
- 1 - Jackhammer – as necessary to assist in rock removal

8. Rock Removal – Blasting
   - 2 - Rock Drills – for drilling holes in rock for explosive charges
   - 2 - Compressors (air) – to provide compressed air for tools and assist in drilling holes in rock
   - 2 - Pneumatic Tools – to assist drilling holes in rock for explosive charges
   - 1 - Jackhammer – as necessary to assist in rock removal
   - 1 – Blasting – for rock removal
   - 2 - Excavators – to remove the blasted rock debris
   - 2 - Front End Loaders – to remove the blasted rock debris
   - 2 - Dump Trucks – to remove the blasted rock debris
   - 2 - Pickup Trucks – transportation for labor staff
   - 1 - Generator – to provide electricity on-site
   - 1 - Warning Horn – blast warning horn prior to blast to alert public
9. Westbound Construction of Retaining Walls and Tunnel Walls
   - 2 - Drill Rig Trucks – to install secant wall
   - 2 - Auger Drill Rigs – to install secant wall
   - 1 - Crane – to install secant wall reinforcing
   - 2 - Concrete Mixer Truck – to deliver concrete for installation of secant wall
   - 2 - Excavators – to remove drilling spoils
   - 2 - Dump Trucks – to remove drilling spoils
   - 3 - Pickup Trucks – transportation for labor staff
   - 1 - Generator – to provide electricity on-site

Table 7
Construction Equipment Planned for the Build Alternative

Equipment Description	Impact Device (Y or N)	Acoustical Usage Factor (%)*	L_{max} at 50 feet (dB(A))
Excavator	No	40	80.7
Mounted Impact Hammer (hoe ram)	Yes	20	90.3
Pneumatic Tools	No	50	85.2
Front End Loader	No	40	79.1
Dump Truck	No	40	76.5
Pickup Truck	No	40	75
Generator	No	50	80.6
Concrete Saw	No	20	89.6
Jackhammer	Yes	20	88.9
Compressor (air)	No	40	77.7
Drill Rig Truck	No	20	79.1
Auger Drill Rig	No	20	84.4
Concrete Mixer Truck	No	40	78.8
Vibratory Pile Driver	No	20	100.8
Crane	No	16	80.6
Man Lift	No	20	74.7
Welder / Torch	No	40	74
Dozer	No	40	81.7
Rock Drill	No	20	81
Blasting	Yes	1	94
Warning Horn	No	5	83.2

Notes:
L_{max} is the maximum sound level.
Construction equipment identified above corresponds to the types of construction equipment expected to be used on this Project.
*Acoustical Usage Factor is an estimate of the fraction of time each piece of construction equipment is operating at full power (i.e., its loudest condition) during a construction operation.
Source: Acoustical usage factor percentages and L_{max} values are from FHWA Roadway Construction Noise Model User's Guide, FHWA-HEP-05-054, DOT-VNTSC-FHWA-05-01 (Final Report, January 2006).

Most of the construction scenarios noted above would be sequential operations; however, there is a potential that some operations would overlap (e.g., soil overburden and rock removal operations). The simultaneous use of construction equipment during the proposed three-to-four-year construction stage would generate temporary elevated noise levels, although this approach would allow for shorter construction stage duration and therefore a shorter period of construction noise. Due to the logarithmic nature of adding noise sources, noise from the simultaneous use of more pieces of the construction equipment listed above may, in some cases, have a negligible effect on perceptible noise levels; therefore, shorter construction duration could be desirable from a construction noise perspective. A greater than 3 dB(A) increase, which is normally the smallest change in noise levels that is perceptible to the human ear, would require a doubling of the noise energy produced by the construction equipment. Even in a case where an accelerated construction schedule creates a perceptible increase in noise levels, shorter construction duration may nonetheless be desirable to affected individuals.

The construction equipment, utilization percentage, and expected maximum noise level (L_{max}) values listed in **Table 7** were used within the models. The RCNM software bases its L_{eq} time period on the usage factor. Usage factor is the percentage of time during a construction noise operation that a piece of construction equipment is operating at full power.

The RCNM analysis yielded L_{eq} and total L_{max} results for all nine construction scenarios within the six chosen distances and under both depressed and at-grade roadway conditions. The RCNM software refers to total L_{eq} and total L_{max} as follows:

- Total L_{eq} is the "equivalent sound level" and is defined in the RCNM manual as the level of a steady sound, which, in a stated time period and at a stated location, has the same sound energy as the time-varying sound. In general, it is the average sound pressure level during a period of time.
- Total L_{max} is the value for the loudest piece of equipment.

The NYSDOT Noise Policy states that, for urban projects, a construction noise impact will not normally occur at levels under L_{eq}=80 dB(A). The RCNM results indicate that all nine scenarios studied would have L_{eq} and L_{max} noise levels of ≥ 80 dB(A) at distances of 100-150 feet or less during Project construction (**Table 8**). **Table 8** shows L_{eq} and L_{max} noise levels for each scenario and at each analyzed distance under the following three conditions:

1) Unadjusted Noise Level Totals – These are the total noise levels that would be anticipated if there were no intervening buildings or other barriers. Note that these conditions are rare within the corridor as most locations have intervening barriers at some distances within 300 feet (e.g. retaining walls or buildings) that would affect noise levels (see conditions 2 and 3 below).
2) Depressed Adjusted Noise Level Totals – These are total noise levels that have been adjusted for areas where the Kensington Expressway construction is below grade to an extent that there is no line-of-sight between the construction equipment and the receivers. Note that for distances of 200 ft or greater it was assumed that intervening buildings are present that would block the receiver's line-of-sight to the construction equipment.
3) At-Grade Adjusted Noise Level Totals – These are total noise levels that have been adjusted for distances of 200 ft or greater where it was assumed that intervening buildings are present that would block the receiver's line-of-sight to the construction equipment.

The use of impact-related construction equipment (impact devices) is planned in six of the nine construction scenarios. Impact construction equipment is equipment that generates short duration (generally less than one second), high intensity, and abrupt impulsive noise. The following six of the nine construction scenarios would include impact devices:

- Removal of Existing Retaining Walls (mounted impact hammer {i.e., hoe ram} and jackhammer)
- Bridge Demolition (mounted impact hammer {i.e., hoe ram} and jackhammer)
- Center Tunnel Wall Construction (mounted impact hammer {i.e., hoe ram})
- Soil Overburden Removal (mounted impact hammer {i.e., hoe ram})
- Rock Removal -Mechanical Means (mounted impact hammer {i.e., hoe ram} and jackhammer)
- Rock Removal -Blasting (blasting and jackhammer)

While the noise levels for impact devices is below 80 dB(A) for many of the receiver distances, impact devices can be more noticeable due to the abrupt changes in noise levels. Therefore, even the represented locations with L_{max} noise levels below 80 dB(A) could experience construction noise effects. The implementation of noise abatement measures during construction (as discussed in **Section 5.1**) would lessen these effects.

Table 8
RCNM Calculated Construction Noise Levels for the Build Alternative

Distance from Center of Construction (ft)	Unadjusted Noise Level Total L_{eq} (dB(A))	Unadjusted Noise Level Total L_{max} (dB(A))	Depressed Adjusted Noise Level Total L_{eq} (dB(A))	Depressed Adjusted Noise Level Total L_{max} (dB(A))	At-Grade Adjusted Noise Level Total L_{eq} (dB(A))	At-Grade Adjusted Noise Level Total L_{max} (dB(A))
Construct Support-of-Excavation (SOE) Walls Behind Existing East Retaining Walls						
50.0	94	100	89	95	94	100
100.0	88	94	83	89	88	94
150.0	85	91	80	86	85	91
200.0	82	88	67	73	72	78
250.0	80	86	65	71	70	76
300.0	78	85	63	70	68	75
Removal of Existing Retaining Walls						
50.0	91	90	86	85	91	90
100.0	85	84	80	79	85	84
150.0	82	80	77	75	82	80
200.0	79	78	64	63	69	68
250.0	77	76	62	61	67	66
300.0	76	74	61	59	66	64
New Retaining Wall and East Tunnel Wall Construction						
50.0	86	84	81	79	86	84
100.0	80	78	75	73	80	78
150.0	76	74	71	69	76	74
200.0	74	72	59	57	64	62
250.0	72	70	57	55	62	60
300.0	70	68	55	53	60	58
Bridge Demolition						
50.0	91	90	86	85	91	90
100.0	85	84	80	79	85	84
150.0	82	80	77	75	82	80
200.0	79	78	64	63	69	68
250.0	77	76	62	61	67	66
300.0	76	74	61	59	66	64

Table 8
RCNM Calculated Construction Noise Levels for the Build Alternative

Distance from Center of Construction (ft)	Unadjusted Noise Level Total L_{eq} (dB(A))	Unadjusted Noise Level Total L_{max} (dB(A))	Depressed Adjusted Noise Level Total L_{eq} (dB(A))	Depressed Adjusted Noise Level Total L_{max} (dB(A))	At-Grade Adjusted Noise Level Total L_{eq} (dB(A))	At-Grade Adjusted Noise Level Total L_{max} (dB(A))
Center Tunnel Wall Construction						
50.0	89	90	84	85	89	90
100.0	83	84	78	79	83	84
150.0	79	80	74	75	79	80
200.0	77	78	62	63	67	68
250.0	75	76	60	61	65	66
300.0	73	74	58	59	63	64
Soil Overburden Removal						
50.0	89	90	84	85	89	90
100.0	83	84	78	79	83	84
150.0	79	80	74	75	79	80
200.0	77	78	62	63	67	68
250.0	75	76	60	61	65	66
300.0	73	74	58	59	63	64
Rock Removal -Mechanical Means						
50.0	91	90	86	85	91	90
100.0	85	84	80	79	85	84
150.0	81	80	76	75	81	80
200.0	79	78	64	63	69	68
250.0	77	76	62	61	67	66
300.0	75	74	60	59	65	64
Rock Removal -Blasting						
50.0	89	94	84	89	89	94
100.0	83	88	78	83	83	88
150.0	79	84	74	79	79	84
200.0	77	82	62	67	67	72
250.0	75	80	60	65	65	70
300.0	73	78	58	63	63	68
Construction of Retaining Walls and West Tunnel Walls						
50.0	86	84	81	79	86	84
100.0	80	78	75	73	80	78

Table 8
RCNM Calculated Construction Noise Levels for the Build Alternative

Distance from Center of Construction (ft)	Unadjusted Noise Level Total L_{eq} (dB(A))	Unadjusted Noise Level Total L_{max} (dB(A))	Depressed Adjusted Noise Level Total L_{eq} (dB(A))	Depressed Adjusted Noise Level Total L_{max} (dB(A))	At-Grade Adjusted Noise Level Total L_{eq} (dB(A))	At-Grade Adjusted Noise Level Total L_{max} (dB(A))
150.0	76	74	71	69	76	74
200.0	74	72	59	57	64	62
250.0	72	70	57	55	62	60
300.0	70	68	55	53	60	58

Notes:
L_{max} is the maximum sound level.
L_{eq} (equivalent sound level) is the sound pressure level equivalent to the total sound energy over a given period of time.
Per RCNM User's Guide, construction noise generated within partially enclosed areas (e.g., depressed roadway) should be reduced by 5 dB(A) and areas shielded by buildings should be reduced by 15 dB(A). For this analysis, partial shielding of 10 dB(A) was assumed for distances of 200 ft or greater.
Source: Analysis performed using FHWA Roadway Construction Noise Model (RCNM) Version 1.1.

The RCNM results indicated that average noise levels and maximum noise levels would be considered disruptive to nearby receivers within a range of approximately 150 feet and closer. The six distances used in the analysis assume construction is occurring directly in front of the receiver in question; however, realistically, given the mobile nature of road construction, the distances between the construction activities and receivers would change as the construction operations move along the length of the roadway. In addition, construction operations are in constant flux, and the equipment and operations would not always be at the worst-case levels predicted herein.

As described in **Section 5.1**, the NYSDOT would require the Contractor to implement construction protocols and practices to abate construction noise.

5.1 Construction Noise Abatement

As indicated in **Section 4.20, Construction Effects of the DDR/EA**, a Construction Noise Mitigation Plan would be developed during final design and would include the following components:

- Implement a construction noise monitoring program, including establishing the noise levels that would trigger the need for investigation and/or changes to construction approaches. These noise levels would be determined during final design. If the noise levels are exceeded, the applicable construction activities would be suspended until a plan to abate the noise issues has been approved by the NYSDOT. The construction noise monitoring program would be prepared with input from the community and allow for modification of methodologies in consideration of public input received throughout construction. The results of the noise monitoring would be available on the Project website. The public would also have the opportunity to discuss any questions or concerns with the community liaison designated for the Project and/or by visiting the staffed project outreach office.

- Coordinate work operation to coincide with time periods that would least affect neighboring residences and businesses to the extent practicable. Normal work hours would be scheduled between 6:00 a.m. and 9:00 p.m. The City of Buffalo's noise ordinance restricts construction work (including building, excavating, hoisting, grading, and pneumatic hammering) between the hours of 9:00PM and 7:00AM that would cause "sound which annoys or disturbs a reasonable person of normal sensitivities in a residential real property zone."[3] Although the NYSDOT is not subject to local noise ordinances, the contractor would implement reasonable efforts to accommodate the intent of the local ordinance to the extent practicable. No blasting or mechanical rock removal would be performed at night.
- Implement temporary construction noise abatement measures, such as shrouds or other noise curtains, acoustic fabric, physical barriers, and/or enclosures to reduce noise from pile drivers, compressors, generators, pumps, and other equipment when practicable. The need for each of these temporary measures would be assessed during final design. The effectiveness and need of these temporary measures would also be assessed in real-time throughout construction based on public input (e.g., noise concerns) and the construction noise monitoring program.
- Require motorized construction equipment to be equipped with an appropriate well-maintained muffler and require silencers to be installed on both air intakes and air exhaust when practicable.
- Require all construction devices with internal combustion engines to be operated with engine doors closed and with noise-insulating material mounted on the engine housing that does not interfere with the manufacture guidelines.
- Require the contractor to transport construction equipment and vehicles carrying rock, concrete, or other materials along designated routes that would cause the least disturbance to noise sensitive receivers when practicable.
- Require self-adjusting or manual audible back up alarms or broadband alarms in lieu of pure tone alarms for vehicles and equipment used in areas adjacent to sensitive noise receivers.
- Require the contractor to use pre-auguring equipment to reduce the duration of impact or vibratory pile driving when practicable.

The Project's community outreach office will remain open and the community liaisons dedicated to the Project will continue to be available to support continuous community engagement during construction.

The RCNM User's Guide provides a list of simplified shielding factors and accompanying noise reduction levels for construction equipment. The list of shielding factors that could apply to the construction of the Build Alternative include:

- Noise barrier or other obstruction (such as a dirt mound) just barely breaks the line-of-sight between the noise source and the receiver: 3 dB(A) noise reduction.
- Noise source is completely enclosed or completely shielded with a solid barrier located close to the source: 8 dB(A) noise reduction (enclosure and/or barrier has some gaps in it: 5 dB(A) noise reduction).
- Noise source is completely enclosed and completely shielded with a solid barrier located close to the source: 10 dB(A) noise reduction.

[3] https://ecode360.com/11767329

- Building stands between the noise source and receiver and completely shields the noise source: 15 dB(A) noise reduction.
- Noise source is enclosed or shielded with heavy vinyl noise curtain material (e.g., SoundSeal BBC-13-2” or equivalent): 5 dB(A) noise reduction.

For each of the nine construction scenario locations that were analyzed, physical features were identified, if present, that could help in reducing temporarily elevated noise levels due to the operation of construction equipment. The depressed roadway, retaining walls, elevation changes, and intervening buildings (at distance) were accounted for in the calculations as indicated in **Table 8**.

6 Construction Vibration

Construction activities have the potential to produce vibration levels that may result in damage, annoyance, and/or interference with vibration-sensitive activities. In general, vibration effects at a specific location are a function of the source strength (which is dependent upon the construction equipment and methods utilized), the distance between the equipment and the location, the characteristics of the transmitting medium, and the building construction type at the location. Construction vibration comprises two types of vibration: vibration generated by mechanical equipment, which tends to be more continuous, and blast vibration, which is brief and episodic. Mechanical and blasting-related vibration are each discussed separately below. For each type of vibration, two types of effects are considered: 1) the potential for cosmetic damage to structures (threshold damage), and 2) the potential annoyance effects of vibration on building occupants. Vibration levels below the potential for threshold damage can still be perceptible.

Vibration refers to oscillatory movement in a solid object (e.g., ground, structures) and can be quantified as acceleration, velocity, or displacement. These quantities can be measured on either linear or logarithmic scales, depending on the levels to be expressed. For engineering purposes, particle velocity is used as the appropriate descriptor. Particle velocity is the motion of a point on the ground relative to its rest state as a vibration wave passes. The assessment of construction vibration for the Project quantifies vibration for both the potential for damage and the potential for annoyance. For damage potential, vibration is described in terms of peak particle velocity (PPV) as inches/second, which is the maximum absolute value of particle velocity as the wave passes. For annoyance, vibration is described in terms of Root Mean Square (RMS) average of the particle velocity as vibration decibels (VdB) referenced to 1 micro-inch/second. Vibration levels expressed in VdB are expressed across a spectrum of frequencies for the vibration. Frequency is the rate at which acceleration, velocity, or displacement fluctuates in a cycle over a given quantity of time and is measured in Hertz (Hz), where 1 Hz equals 1 cycle per second. Vibration levels expressed as PPV refer to the total PPV across the full frequency spectrum.

Construction equipment operation generates ground vibration, which propagates through the ground and decreases in strength with distance. Vehicular traffic, including construction-related vehicular and equipment traffic, typically does not result in perceptible vibration levels unless there are discontinuities in the roadway surface. Construction activities typically do not generate vibration levels that can cause damage, although fragile structures or buildings are more prone to be affected. The type of potential damage to structures surrounding construction activities is termed “threshold damage.” This is cosmetic damage to surfaces such as drywall or plaster and is usually generated at high stress concentrators such as the corners of windows or doorways. However, construction work can also produce vibration levels that may interfere with uses in adjacent buildings that are especially sensitive to vibration, including activities (such as surgery) or the use of equipment (such as microscopes and high tolerance manufacturing equipment). Levels may be perceptible and annoying in buildings very close to a construction site.

In accordance with the NYSDOT Highway Design Manual (HDM) Section 9.6 "Building Condition Survey and Vibration Monitoring (Non Blasting)," non-blasting construction operations (e.g., excavation, pavement removal, backfill and compaction, demolition, driving of piles and sheeting, etc. –including tunnel boring) may damage or distress adjacent sensitive buildings, structures, or utilities. The NYSDOT has prepared special specifications and notes for building condition surveys, vibration monitoring, and vibration criteria that are to be used during construction operations that may produce vibration levels of concern. NYSDOT's Building Condition Survey and Vibration Monitoring (Non Blasting) specifications are Items 634.99010017 and 634.99020017, respectively. Monitoring vibrations generated via blasting operations are also controlled by Standard Specifications Section 203 and are described in the Geotechnical Engineering Manual (GEM22) Procedures for Blasting.

6.1 Vibration Criteria for Mechanical Excavation

There are no FHWA or NYSDOT requirements directed specifically toward traffic-induced or construction-related vibration[4]. However, criteria from the Federal Transit Administration's (FTA) Transit Noise and Vibration Impact Assessment Manual[5] were used to assess construction vibration related to this Project. The analysis focused on the types of mechanical equipment expected to be used during construction that generate the highest vibration levels: vibratory pile drivers and hoe rams. Impact pile driving, which generates higher vibration levels than vibratory pile driving, is not proposed for this Project. The distance at which potential building damage and annoyance effects could occur was predicted and compared to the distances of structures in the Study Area to the locations of construction activity.

- Potential Damage from Vibration: For purposes of assessing potential threshold damage due to mechanical construction activities, the determination of adverse effects was based on the vibration impact criterion of a PPV of 0.20 inches per second. For the typical buildings in the neighborhoods of proposed construction activities, vibration levels below 0.20 inches per second would not be expected to result in any threshold damage. For fragile buildings, vibration levels should be below 0.12 inches per second.
- Human Perceptibility and Annoyance from Vibration: The FTA's guidance manual identifies threshold vibration levels that would be perceptible to humans within buildings and may result in annoyance, depending on the type of use (e.g., residential, school). Since the ability to perceive vibration is subjective, a range of possible vibration levels is identified in the FTA guidance manual, specifically between 72 and 83 VdB. For the purposes of this analysis, the lower limit of the range (72 VdB) was used as the threshold at which vibration may result in human annoyance.

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[4]https://www.fhwa.dot.gov/Environment/noise/regulations_and_guidance/analysis_and_abatement_guidance/polguide09.cfm

[5] https://www.transit.dot.gov/sites/fta.dot.gov/files/docs/research-innovation/118131/transit-noise-and-vibration-impact-assessment-manual-fta-report-no-0123_0.pdf

- Vibration Sensitive Activities and Equipment: Properties containing vibration sensitive activities and equipment have not been identified within the Study Area. Should such special land uses/activities be identified, vibration criteria specifically provided for equipment by the equipment's manufacturer provide the most accurate threshold by which to judge the potential effects of vibration on vibration-sensitive equipment. However, acceptable vibration-level specifications may not be available for all vibration-sensitive equipment potentially operating in the project work areas. If manufacturer-provided equipment-specific vibration criteria are unavailable, general criteria outlined in the FTA Noise and Vibration Impact Assessment Manual, Chapter 7, would be used for the vibration assessment (see **Table 9**).

Table 9
Interpretation of Vibration Criteria for Vibration Analysis

Criterion Curve	Max Lv,* VdB	Description of Use
Workshop (ISO)	90	Vibration that is distinctly felt. Appropriate for workshops and similar areas not as sensitive to vibration.
Office (ISO)	84	Vibration that can be felt. Appropriate for offices and similar areas not as sensitive to vibration.
Residential Day (ISO)	78	Vibration that is barely felt. Adequate for computer equipment and low-power optical microscopes (up to 20X).
Residential Night, Operating Rooms (ISO)	72	Vibration is not felt, but ground-borne noise may be audible inside quiet rooms. Suitable for medium-power optical microscopes (100X) and other equipment of low sensitivity.
VC-A	66	Adequate for medium-to high-power optical microscopes (400X), microbalances, optical balances, and similar specialized equipment.
VC-B	60	Adequate for high-power optical microscopes (1000X) and inspection and lithography equipment to 3-micron line widths.
VC-C	54	Appropriate for most lithography and inspection equipment to 1-micron detail size.
VC-D	48	Suitable in most instances for the most demanding equipment, including electron microscopes operating to the limits of their capabilities.
VC-E	42	The most demanding criterion for extremely vibration-sensitive equipment.

Notes:
1. Vibration Classifications (VC) from the Institute of Environmental Sciences and Technology, "Considerations in Clean Room Design," RR-CC012.1, 1993.
2. As measured in 1/3-octave bands of frequency over the frequency range 8 to 80 Hz.
Source: FTA Transit Noise and Vibration Impact Assessment Manual, 2006.

For purposes of assessing the potential for damage to surrounding structures due to mechanical excavation, PPV was used, while the vibration level in VdB, $L_v(D)$, was used to assess potential annoyance or interference with vibration sensitive activities.

6.2 Vibration Criteria for Blasting

In contrast to mechanical excavation, blasting generally generates a shorter duration but higher amplitude vibration. Surface structures do not have the time to respond and amplify the vibration to a substantial extent, so the criteria are adjusted accordingly.

The US Bureau of Mines conducted research into the potential for threshold damage to surrounding structures for decades, culminating in a study completed in 1980, and reported in USBM Report of Investigations 8507[6]. While this study is the most appropriate for this analysis, the study may be considered conservative since it was completed in 1980 and blasting techniques have somewhat improved since then.

6.3 Estimated Vibration Levels for Mechanical Vibration

Table 10 shows vibration reference (PPV_{ref}) levels at 25' distance for typical mechanical construction equipment. The equipment vibration levels were projected to various distances in relation to the proposed work areas to determine the level of vibration for various construction activities (e.g., pile driving, hoe ram, rock drilling,). To determine expected vibration levels at distances other than 25', the following equation is used, from the FTA Guidance Manual:

$$PPV = PPVref \times \left(\frac{25}{D}\right)^{1.5}$$

Construction activities with the highest potential to result in threshold damage due to vibration include vibratory pile driving and potentially blasting. However, it should be noted that less disruptive means of completing operations would be considered during final design. For additional information on construction methods, see **Section 3.5, Construction Means and Methods of the DDR/EA**.

[6] https://vibrationmonitoringcourse.com/wp-content/uploads/sites/7/2014/03/RI-8507-Blasting-Vibration-1989-Org-Scanned-Doc.pdf

Table 10
Vibration Source Levels for Construction Equipment

Equipment		PPV ref at 25 feet (in/sec)	Approximate Lv at 25 feet (VdB)*
Pile Driver (impact)	Upper Range	1.518	112
	Typical	0.644	104
Pile Driver (sonic/vibratory)	Upper Range	0.734	105
	Typical	0.17	93
Clam shovel drop (slurry wall)		0.202	94
Hydromill (slurry wall)	In soil	0.008	66
	In rock	0.017	75
Vibratory roller		0.210	94
Hoe Ram		0.089	87
Large bulldozer		0.089	87
Caisson drilling		0.089	87
Loaded trucks		0.076	86
Jackhammer		0.035	79
Small bulldozer		0.003	58

Source: Transit Noise and Vibration Impact Assessment, FTA-VA-90-1003-06, May 2006.
* RMS velocity in decibels, VdB re 1 micro-in/sec

6.4 Estimated Vibration Levels for Blasting

Vibration from blasting has been shown to follow the following power law calculation from the International Society of Explosive Engineers "Blasters' Handbook"[7]:

$$PPV = 242\left(\frac{D}{\sqrt{W}}\right)^{-1.6}$$

where *D* is the distance in feet of the receptor from the closest point of the blast, and *W* is the charge weight of explosive detonated in each delay period (typically in each explosively-loaded borehole). This is a generic equation based upon many blasts in many locations and is therefore site-specific. Test blasts are detonated prior to production blasting to determine if the constants "242" and "-1.6" need to be adjusted.

The details of the proposed blasting for excavation would be determined during final design; however, the following can be stated at this time based upon the above calculation, with the generic constants:

- If the closest structure is 33 feet from the closest blast, the charge weight should be less than 2.5 pounds per delay.
- If the closest structure is greater than 33 feet, then charge weight can be increased accordingly.
- Charge weight is determined by:
  - Diameter of the borehole
  - Length of the borehole

[7] https://isee.org/store/product/399-18th-edition-blasters-e-handbook-digital-download

- Number of charges in the borehole

Since the closest buildings to the blasting operations are more than 33 feet, it is anticipated that no threshold damage will occur as a result of blasting.

6.5 Vibration Effects from Mechanical Equipment

Potential Building Damage Effects

Based on the type of structures in the Study Area, the potential building damage threshold is 0.20 inches per second peak particle velocity (PPV). The operation of vibratory pile drivers would exceed this threshold at distances of less than 22 feet between the equipment and a structure. The operation of hoe rams would exceed this threshold at distances of less than 15 feet between the equipment and a structure. The closest structures are 33 feet from both operations (pile driving and hoe rams). Therefore, no buildings are expected to experience vibration from mechanical equipment that could potentially cause damage. Distances for potential threshold damage were calculated using the reference values from **Table 10** and the damage assessment formula in Chapter 12 of the FTA Noise and Vibration Manual.

No buildings that would be considered fragile are located within the distance from the proposed construction work areas that could result in PPV levels that would potentially result in damage to fragile structures (i.e., within 32 feet for a vibratory pile driver). The closest buildings are located within 33 feet of proposed pile driving operations; these buildings, consequently, would not be expected to experience construction vibration at a level that could potentially cause damage.

Review of the structures along the corridor identified a number of residential chimneys that are in disrepair and some churches with missing mortar, bricks or stones. As indicated in Section 6.0, there would be pre-construction inspections in areas of vibration concern based on the thresholds established in FTA Noise and Vibration Manual.

Since the closest buildings to the construction operations are more than the distances of concern identified above, no buildings are expected to experience vibration from mechanical equipment that could potentially cause damage.

Underground utilities in the area (including waterlines and brick sewers) are within 22 feet of pile driving operations. However, underground utilities are generally not as sensitive to vibration as aboveground structures since underground structures do not tend to resonate vibration like aboveground structures. Blasting-related vibration levels would be below criteria recommended for protection of underground pipelines. The US Bureau of Mines conducted a study to assess the potential for damage to underground pipelines, reported in Report of Investigations 95238. In that study, vibration criteria with a PPV of 5 in/sec were recommended. Commonly, where there aren't regulations, a criterion of 4 in/sec is also recommended. Therefore, damage to underground utilities is not anticipated.

[8]https://files.dep.state.pa.us/Mining/BureauOfMiningPrograms/BMPPortalFiles/Blasting_Research_Papers/RI%20 9523%20Blasting%20near%20Pipelines%201994%20(No.1).pdf

As described in Section 6.8, the NYSDOT would require that the Contractor comply with the construction practices and protocols developed for the Project. These requirements would include a construction vibration monitoring program to minimize the potential for damage.

Potential Annoyance Effects

For residential structures, the applicable annoyance threshold is 72 vibration decibels (VdB) referenced to 1 micro-inch/second.[9] Vibratory pile driving is the type of equipment with the highest potential for annoyance effects and the vibration analysis showed this type of equipment could generate perceptible vibration levels of 72 VdB or greater at distances of 125 feet or less between a building and the pile driving activity. This distance would generally include the first row of residences along Humboldt Parkway northbound and southbound. However, pile driving would only occur for limited periods of time at each particular pile driving location. The vibration level at a particular residence would increase as the work progresses closer to a residence, then decrease as it moves away along the Project corridor. Pile driving activities would progress along the Project corridor past the residences at different rates (mainly based on the presence of bedrock). It is expected that the maximum duration that any receiver would experience perceptible/annoying levels of vibration from pile driving would be between two to ten weeks. Annoyance effects would be minimized through the mitigation commitments described below, which include vibration monitoring, avoiding pile driving at night, and community outreach during construction. Therefore, adverse effects related to building occupant annoyance are not anticipated.

6.6 Vibration Effects from Blasting

Potential Building Damage Effects

No threshold damage to buildings (i.e., cracking of plaster or drywall) is expected at any properties within the Study Area, regardless of distance from the proposed blasting. The potential for building damage would be avoided through the design of the blasting program, which would take into account the distance and condition of the closest structure (among other factors) in determining the appropriate charge weight per delay. The specifications for the Project would mandate criteria that were developed by the US Bureau of Mines to avoid such damage due to blasting. Furthermore, test blasting would be used to develop blast designs (including charge weights) that are consistent with maintenance of those criteria. Vibration criteria in the specifications would include both Caution and Alert levels, where Alert is the level not to be exceeded, and Caution is a slightly lower level at which blast practices must be reviewed by the NYSDOT and the Contractor.

Although infrequent and below the potential for building damage, blasting vibration would be perceptible. Therefore, to protect the interests of the NYSDOT, the Contractor, and the residents, pre- and post-construction building condition surveys would be implemented for an area up to approximately 300 feet of the proposed blasting locations (this estimated distance for the surveys would be refined during final design, as appropriate). It is important to note that the pre- and post-construction survey area of up to 300 feet does not mean that damage to buildings is expected within

[9] The FTA vibration annoyance threshold is based on studies of the response of people to long-term exposure to transit vibration and is therefore a conservative basis for considering potential construction-related vibration effects. For additional context, 65 VdB is the approximate threshold of perception for many humans; 75 VdB is the approximate dividing line between barely perceptible and distinctly perceptible vibration and many people find transit vibration at this level annoying; and 85 VdB is distinctly perceptible and can result in strong annoyance.

300 feet of blasting. As described above, no damage to buildings is anticipated through the design of the blasting program.

Potential Annoyance Effects

The public would be notified of the times and dates in advance of the blasting. Although the vibration would be perceptible, it is not considered an adverse effect in terms of building occupant annoyance effects due to the short and infrequent nature of blasting. The primary consideration for annoyance effects is pile driving, which would be more continuous throughout the day.

6.7 Vibration Assessment Criteria for Sensitive Equipment or Activities

As described above, the operation of specific equipment and specific activities can be affected by vibration even at levels lower than is perceptible or annoying to humans. No extremely vibration sensitive equipment (e.g., electron microscopes) or land uses (e.g., hospitals) have been identified in the Study Area; therefore, analysis of construction vibration effects on sensitive equipment is not applicable.

6.8 Construction Vibration Abatement

To abate the potential effects from construction vibration, a Construction Vibration Mitigation Plan would be developed during final design and would include the following components:

- Implement a construction vibration monitoring program that includes a communication and public outreach plan throughout the construction period.
  - The construction vibration monitoring program would be prepared with input from the community and allow for modification of methodologies based on public input throughout construction.
  - The results of construction vibration monitoring would be available for the public to view on the project website.
  - NYSDOT would include contract requirement for a public outreach liaison that would conduct proactive outreach ahead of blasting and pile driving activities. Further, the community liaison would be able to accept complaints from the public which would then be assessed by NYSDOT for any appropriate action. If at any time it is determined that vibration levels are unacceptable, the problematic construction operations would be halted until a plan to mitigate the vibration issues has been approved by NYSDOT.
  - Publishing a blasting schedule that will be available at the Project public outreach office;
  - Informing local police and emergency services about the blasting schedule;
  - Pre-blast audio alert procedures, consisting of a well-defined sequence of airhorn blasts prior to a blast and a following all-clear.

- Prohibit nighttime use of impact and drilling equipment including pile drivers, jackhammers, hoe rams, core drills, direct push soil probes (e.g., Geoprobe), pavement breakers, pneumatic tools, and rock drills.
- Direct contractor to use pre-auguring equipment to reduce the duration of vibratory pile driving when reasonable.
- Require contractor to develop and implement a blasting program designed to avoid the potential for damage to structures by modifying the weight of explosives per delay, the loading density, and

the delay pattern consistent with GEM22, the Geotechnical Engineering Manual published by the NYSDOT. Blast vibration would be kept within bounds as determined by USBM RI 8507 and adjusted on an as-needed basis during construction.

- Prior to construction blasting, test blasts would be conducted to assess appropriate explosive charge weights, and if deemed appropriate, industry-standard signature hole analysis.
- Conduct vibration and airblast monitoring per the blasting program.
- Although no threshold damage is expected, any unanticipated damage to buildings or utilities found by the NYSDOT to be attributable to the construction would be repaired by the contractor. Pre- and post-construction surveys of building conditions would be conducted within a survey area of up to approximately 300 feet (this estimated distance for the surveys would be refined during final design, as appropriate).

ATTACHMENT A

Noise Study Land Use Categories Map Showing Study Area

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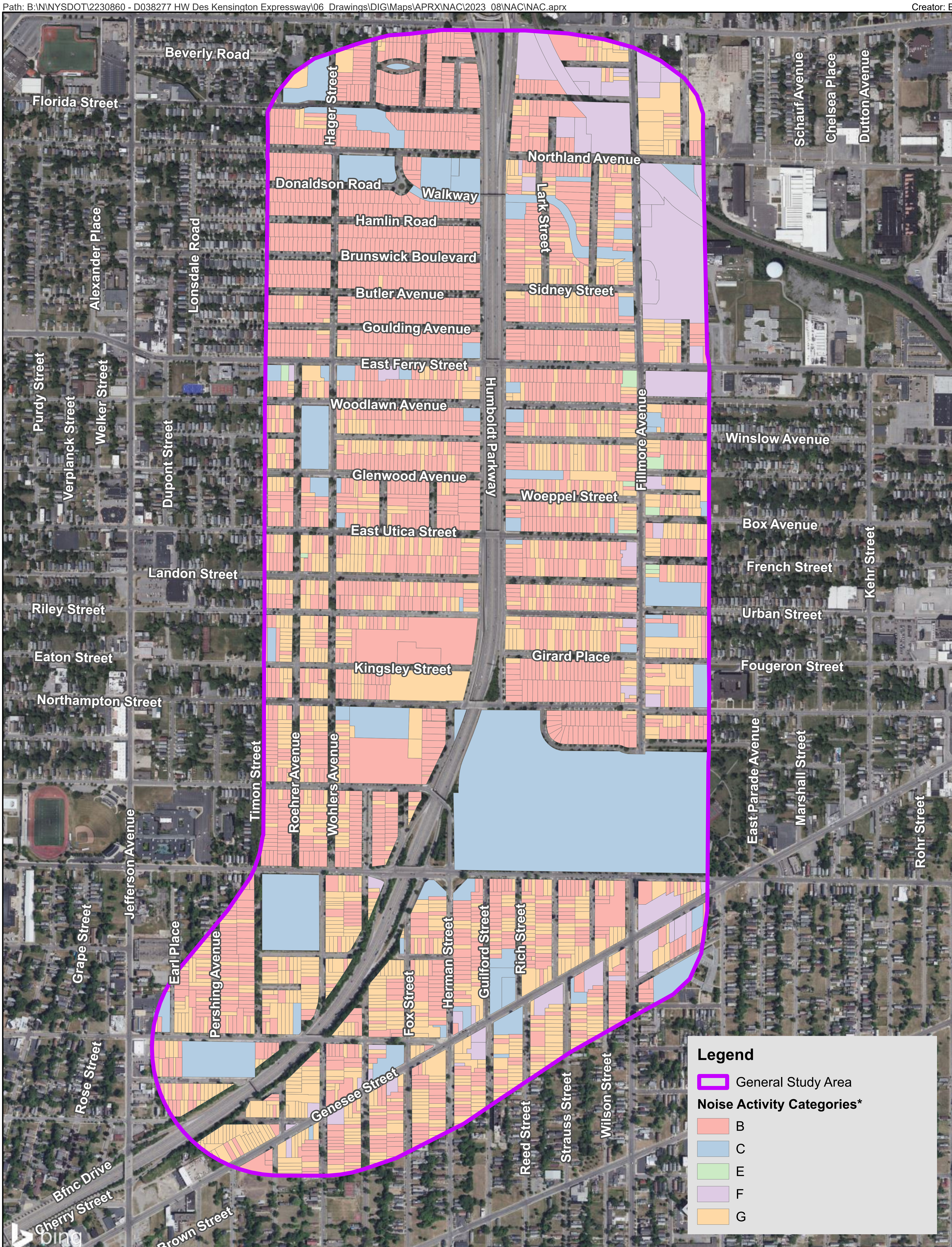

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Figure 2

Noise Study
Land Use Categories

8/21/2023

*Note: This data was created based on land use codes and information provided in Table 5 of the Noise Analysis Report for this project.

Sources: Bing Maps, Code of Federal Regulations 2023, Erie County 2023, LaBella 2023, Watts Architects & Engineers 2023.

N

0 1,000 2,000 US Feet

ATTACHMENT B

Kensington Receivers Map Series Showing Model Results and Comparisons

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Figure 3A

Kensington Receivers

8/21/2023

Legend

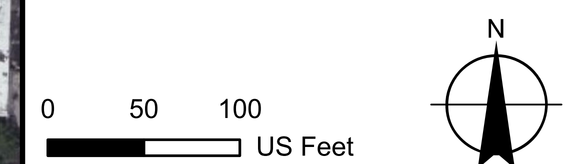
General Study Area

Common Noise Environments

Receiver Noise Level Difference dB(A)

Perceptible noise decrease (greater than 3 dBA decrease No Build to Build)

No perceptible change (increase or decrease of 3dBA or less No Build to Build)



Sources: Bing Maps, 2023; Erie County, 2023; LaBella, 2023; Watts Architects & Engineers, 2023

*Note: Calculation of the number of Equivalent Receptors includes multi-family residences and other land uses as indicated in the NYSDOT Noise Policy.

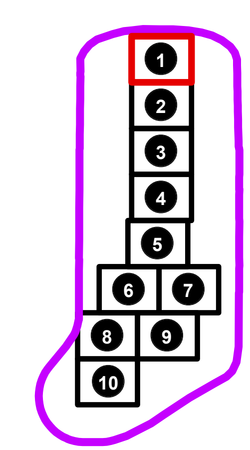


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Figure 3B

Kensington Receivers

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Legend

General Study Area

Common Noise Environments

Receiver Noise Level Difference dB(A)

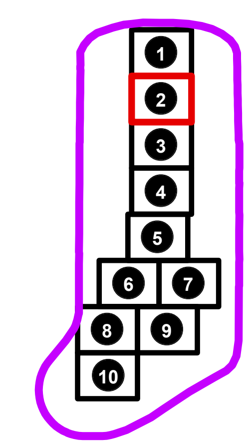
- Perceptible noise decrease (greater than 3 dBA decrease No Build to Build) (yellow)
- No perceptible change (increase or decrease of 3dBA or less No Build to Build) (blue)

0 50 100 US Feet

N

Sources: Bing Maps, 2023; Erie County, 2023; LaBella, 2023; Watts Architects & Engineers, 2023

*Note: Calculation of the number of Equivalent Receptors includes multi-family residences and other land uses as indicated in the NYSDOT Noise Policy.



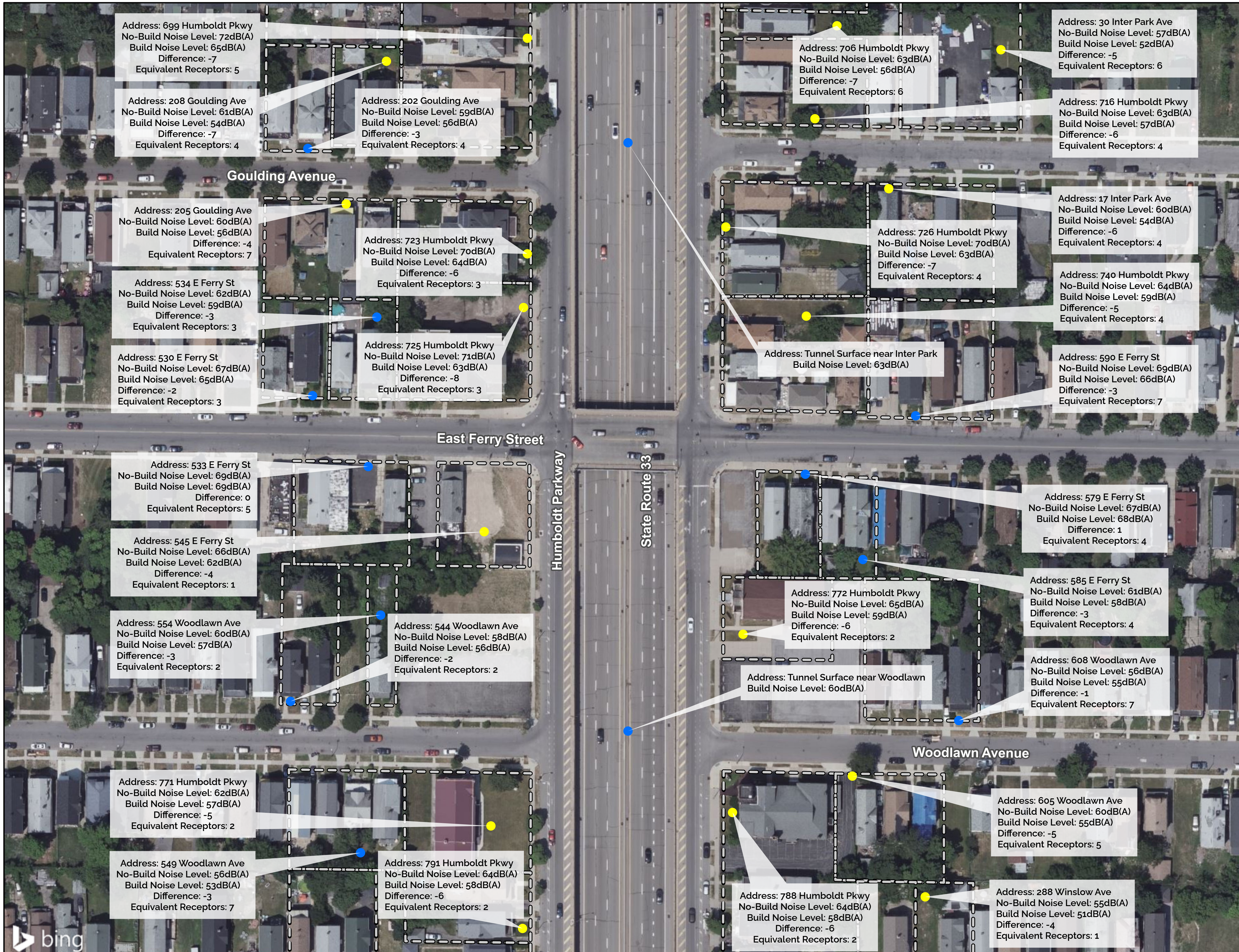


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Figure 3C

Kensington Receivers

8/21/2023

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Legend

General Study Area

Common Noise Environments

Receiver Noise Level Difference dB(A)

Perceptible noise decrease (greater than 3 dBA decrease No Build to Build)

No perceptible change (increase or decrease of 3dBA or less No Build to Build)

N

0 50 100 US Feet

Sources: Bing Maps, 2023; Erie County, 2023; LaBella, 2023; Watts Architects & Engineers, 2023

*Note: Calculation of the number of Equivalent Receptors includes multi-family residences and other land uses as indicated in the NYSDOT Noise Policy.

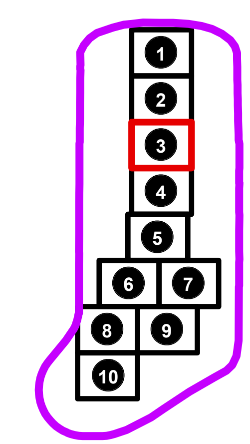

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Figure 3D

Kensington Receivers

8/21/2023

Legend

- General Study Area
- Common Noise Environments

Receiver Noise Level Difference dB(A)

- Perceptible noise decrease (greater than 3 dBA decrease No Build to Build)
- No perceptible change (increase or decrease of 3dBA or less No Build to Build)

N

0 50 100 US Feet

Sources: Bing Maps, 2023; Erie County, 2023; LaBella, 2023; Watts Architects & Engineers, 2023

*Note: Calculation of the number of Equivalent Receptors includes multi-family residences and other land uses as indicated in the NYSDOT Noise Policy.

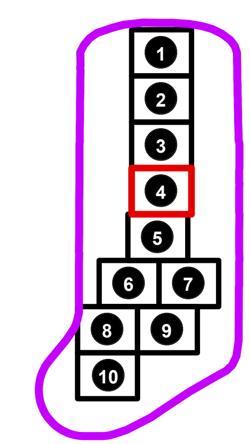

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Figure 3E

Kensington Receivers

8/21/2023

Legend

General Study Area

Common Noise Environments

Receiver Noise Level Difference dB(A)

- Perceptible noise decrease (greater than 3 dBA decrease No Build to Build)
- No perceptible change (increase or decrease of 3dBA or less No Build to Build)

N

0 50 100 US Feet

Sources: Bing Maps, 2023; Erie County, 2023; LaBella, 2023; Watts Architects & Engineers, 2023

*Note: Calculation of the number of Equivalent Receptors includes multi-family residences and other land uses as indicated in the NYSDOT Noise Policy.

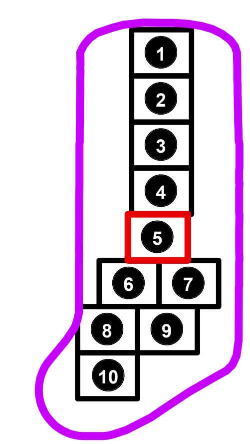

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Figure 3F
Kensington Receivers

8/21/2023

Legend

- General Study Area
- Common Noise Environments

Receiver Noise Level Difference dB(A)

- Perceptible noise decrease (greater than 3 dBA decrease No Build to Build)
- No perceptible change (increase or decrease of 3dBA or less No Build to Build)

0 50 100 US Feet

N

Sources: Bing Maps, 2023; Erie County, 2023; LaBella, 2023; Watts Architects & Engineers, 2023

*Note: Calculation of the number of Equivalent Receptors includes multi-family residences and other land uses as indicated in the NYSDOT Noise Policy.

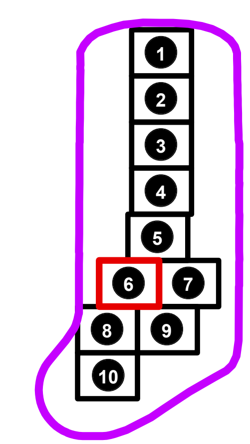

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Figure 3G

Kensington Receivers

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Legend

General Study Area

Common Noise Environments

Receiver Noise Level Difference dB(A)

Perceptible noise decrease (greater than 3 dBA decrease No Build to Build)

No perceptible change (increase or decrease of 3dBA or less No Build to Build)

N

0 50 100 US Feet

Sources: Bing Maps, 2023; Erie County, 2023; LaBella, 2023; Watts Architects & Engineers, 2023

*Note: Calculation of the number of Equivalent Receptors includes multi-family residences and other land uses as indicated in the NYSDOT Noise Policy.

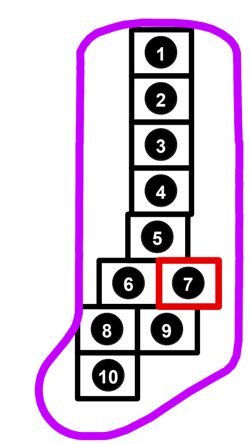

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Figure 3H

Kensington Receivers

8/21/2023

Legend

General Study Area

Common Noise Environments

Receiver Noise Level Difference dB(A)

Perceptible noise decrease (greater than 3 dBA decrease No Build to Build)

No perceptible change (increase or decrease of 3dBA or less No Build to Build)

0 50 100 US Feet

N

Sources: Bing Maps, 2023; Erie County, 2023; LaBella, 2023; Watts Architects & Engineers, 2023

*Note: Calculation of the number of Equivalent Receptors includes multi-family residences and other land uses as indicated in the NYSDOT Noise Policy.

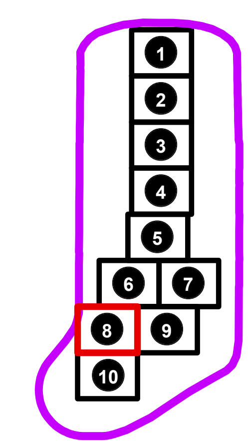

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Figure 3I

Kensington Receivers

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Legend

General Study Area

Common Noise Environments

Receiver Noise Level Difference dB(A)

Perceptible noise decrease (greater than 3 dBA decrease No Build to Build)

No perceptible change (increase or decrease of 3dBA or less No Build to Build)

0 50 100 US Feet

N

Sources: Bing Maps, 2023; Erie County, 2023; LaBella, 2023; Watts Architects & Engineers, 2023

*Note: Calculation of the number of Equivalent Receptors includes multi-family residences and other land uses as indicated in the NYSDOT Noise Policy.

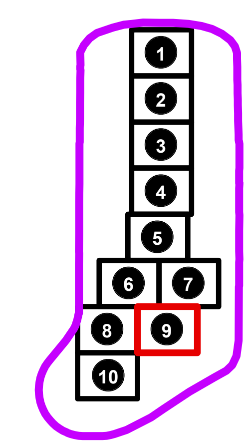

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Figure 3J

Kensington Receivers

8/21/2023

Legend

- General Study Area
- Common Noise Environments

Receiver Noise Level Difference dB(A)

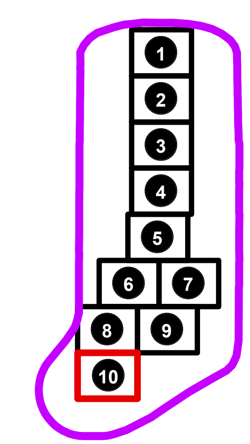
- Perceptible noise decrease (greater than 3 dBA decrease No Build to Build)
- No perceptible change (increase or decrease of 3dBA or less No Build to Build)

N

0 50 100 US Feet

Sources: Bing Maps, 2023; Erie County, 2023; LaBella, 2023; Watts Architects & Engineers, 2023

*Note: Calculation of the number of Equivalent Receptors includes multi-family residences and other land uses as indicated in the NYSDOT Noise Policy.



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ATTACHMENT C

Noise Summary – Model Results

Table: Noise Summary - Model Results

PIN 5512.52 - NYS Route 33, Kensington Expressway Project, City of Buffalo, Erie County, New York

Address	Land Use	Receptors (Equivalent Number of Residences)	2047 No-Build Alternative (dB(A))	2047 Build Alternative (dB(A))	Change from No-Build to Build (dB(A))
485 Best St	C - School	8	45	44	-1
555 Best St	B - Residential	1	66	66	0
561 Best St	B - Residential	4	60	58	-2
623 Best St	C - Place of Worship	3	65	61	-4
653 Best St	C - Place of Worship	2	60	58	-2
246 Brunswick Blvd	B - Residential	2	61	58	-3
251 Brunswick Blvd	B - Residential	6	63	59	-4
254 Brunswick Blvd	B - Residential	2	63	59	-4
255 Brunswick Blvd	B - Residential	1	63	56	-7
202 Butler Ave	B - Residential	9	58	54	-4
209 Butler Ave	B - Residential	7	62	57	-5
8 Dignity Cir	B - Residential	2	66	66	0
9 Dignity Cir	B - Residential	2	64	64	0
19 Dignity Cir	B - Residential	2	61	61	0
20 Dignity Cir	B - Residential	4	60	61	1
28 Dignity Cir	B - Residential	3	55	55	0
564 Dodge St	B - Residential	8	58	57	-1
594 Dodge St	B - Residential	3	64	60	-4
530 E Ferry St	B - Residential	3	67	65	-2
533 E Ferry St	B - Residential	5	69	69	0
534 E Ferry St	B - Residential	3	62	59	-3
545 E Ferry St	B - Residential	1	66	62	-4
579 E Ferry St	B - Residential	4	67	68	1
585 E Ferry St	B - Residential	4	61	58	-3
590 E Ferry St	B - Residential	7	69	66	-3
543 E North St	B - Residential	2	58	58	0
550 E North St	B - Residential	1	54	53	-1
553 E North St	B - Residential	2	71	71	0
600 E North St	E - Restaurant	1	62	62	0
606 E North St	B - Residential	2	55	54	-1
607 E North St	B - Residential	1	52	52	0
568 E Utica St	B - Residential	9	63	60	-3
569 E Utica St	B - Residential	6	62	62	0
629 E Utica St	B - Residential	4	63	64	1
630 E Utica St	B - Residential	9	57	53	-4
391 Florida St	B - Residential	1	60	60	0
397 Florida St	B - Residential	4	62	62	0
364 Fox St	B - Residential	8	56	56	0
409 Fox St	B - Residential	2	55	52	-3
415 Fox St	B - Residential	1	67	65	-2
13 Girard Pl	B - Residential	7	55	50	-5
18 Girard Pl	B - Residential	2	56	50	-6
20 Girard Pl	B - Residential	1	54	49	-5
555 Glenwood Ave	B - Residential	3	54	52	-2
558 Glenwood Ave	B - Residential	1	55	53	-2
560 Glenwood Ave	B - Residential	1	54	50	-4
202 Goulding Ave	B - Residential	4	59	56	-3
205 Goulding Ave	B - Residential	7	60	56	-4
208 Goulding Ave	B - Residential	4	61	54	-7
204 Hamlin Rd	B - Residential	3	61	61	0
207 Hamlin Rd	B - Residential	5	63	61	-2
210 Hamlin Rd	B - Residential	1	63	61	-2

Table: Noise Summary - Model Results
PIN 5512.52 - NYS Route 33, Kensington Expressway Project, City of Buffalo, Erie County, New York

Address	Land Use	Receptors (Equivalent Number of Residences)	2047 No-Build Alternative (dB(A))	2047 Build Alternative (dB(A))	Change from No-Build to Build (dB(A))
376 Herman St	B - Residential	6	54	52	-2
394 Herman St	B - Residential	1	57	55	-2
503 High St	B - Residential	8	66	66	0
513 High St	B - Residential	3	64	65	1
526 High St	C - Place of Worship	2	65	65	0
555 High St	B - Residential	2	60	60	0
557 High St	B - Residential	5	63	63	0
576 High St	B - Residential	2	57	57	0
517 Humboldt Pkwy	B - Residential	4	62	62	0
537 Humboldt Pkwy	B - Residential	3	68	68	0
543 Humboldt Pkwy	B - Residential	7	61	61	0
559 Humboldt Pkwy	B - Residential	7	72	72	0
562 Humboldt Pkwy	B - Residential	3	71	71	0
566 Humboldt Pkwy	B - Residential	6	69	69	0
573 Humboldt Pkwy	B - Residential	5	72	71	-1
575 Humboldt Pkwy	C - Place of Worship	1	73	73	0
577 Humboldt Pkwy	C - Park	4	67	67	0
612 Humboldt Pkwy	B - Residential	2	74	74	0
614 Humboldt Pkwy	B - Residential	4	66	67	1
621 Humboldt Pkwy	B - Residential	3	74	73	-1
622 Humboldt Pkwy	C - Park	4	67	67	0
626 Humboldt Pkwy	C - Place of Worship	4	74	75	1
638 Humboldt Pkwy	B - Residential	4	65	65	0
641 Humboldt Pkwy	B - Residential	5	74	72	-2
652 Humboldt Pkwy	B - Residential	4	74	74	0
660 Humboldt Pkwy	B - Residential	3	65	62	-3
670 Humboldt Pkwy	B - Residential	5	74	74	0
673 Humboldt Pkwy	B - Residential	5	74	70	-4
684 Humboldt Pkwy	B - Residential	6	64	59	-5
699 Humboldt Pkwy	B - Residential	5	72	65	-7
700 Humboldt Pkwy	B - Residential	4	72	64	-8
706 Humboldt Pkwy	B - Residential	6	63	56	-7
716 Humboldt Pkwy	B - Residential	4	63	57	-6
723 Humboldt Pkwy	B - Residential	3	70	64	-6
725 Humboldt Pkwy	C - School	3	71	63	-8
726 Humboldt Pkwy	B - Residential	4	70	63	-7
740 Humboldt Pkwy	B - Residential	4	64	59	-5
771 Humboldt Pkwy	C - Place of Worship	2	62	57	-5
772 Humboldt Pkwy	C - Place of Worship	2	65	59	-6
788 Humboldt Pkwy	C - Place of Worship	2	64	58	-6
791 Humboldt Pkwy	B - Residential	2	64	58	-6
795 Humboldt Pkwy	B - Residential	1	58	56	-2
803 Humboldt Pkwy	B - Residential	3	57	57	0
815 Humboldt Pkwy	B - Residential	8	65	58	-7
818 Humboldt Pkwy	B - Residential	11	64	57	-7
835 Humboldt Pkwy	B - Residential	3	63	57	-6
840 Humboldt Pkwy	C - Medical Facility	2	62	56	-6
845 Humboldt Pkwy	B - Residential	2	57	52	-5
850 Humboldt Pkwy	B - Residential	9	56	54	-2
855 Humboldt Pkwy	B - Residential	6	65	59	-6
860 Humboldt Pkwy	B - Residential	2	60	57	-3
866 Humboldt Pkwy	B - Residential	3	66	60	-6

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Address	Land Use	Receptors (Equivalent Number of Residences)	2047 No-Build Alternative (dB(A))	2047 Build Alternative (dB(A))	Change from No-Build to Build (dB(A))
874 Humboldt Pkwy	B - Residential	2	68	63	-5
889 Humboldt Pkwy	B - Residential	2	70	61	-9
890 Humboldt Pkwy	C - Place of Worship	1	67	65	-2
893 Humboldt Pkwy	B - Residential	8	60	54	-6
896 Humboldt Pkwy	B - Residential	9	68	61	-7
915 Humboldt Pkwy	B - Residential	2	66	58	-8
924 Humboldt Pkwy	B - Residential	3	60	53	-7
925 Humboldt Pkwy	B - Residential	4	60	54	-6
932 Humboldt Pkwy	B - Residential	4	58	51	-7
936 Humboldt Pkwy	B - Residential	3	68	56	-12
954 Humboldt Pkwy	B - Residential	2	70	57	-13
992 Humboldt Pkwy	B - Residential	4	64	55	-9
1008 Humboldt Pkwy	B - Residential	4	61	57	-4
1016 Humboldt Pkwy	B - Residential	1	60	58	-2
17 Inter Park Ave	B - Residential	4	60	54	-6
30 Inter Park Ave	B - Residential	6	57	52	-5
308 Johnson St	B - Residential	5	67	67	0
352 Johnson St	B - Residential	1	63	64	1
369 Johnson St	B - Residential	1	70	70	0
376 Johnson St	B - Residential	2	58	58	0
228 Kingsley St	B - Residential	8	54	52	-2
239 Landon St	B - Residential	3	51	48	-3
242 Landon St	B - Residential	1	53	49	-4
246 Landon St	B - Residential	3	52	49	-3
253 Landon St	B - Residential	4	57	51	-6
306 Landon St	B - Residential	2	58	52	-6
311 Landon St	B - Residential	4	55	48	-7
316 Landon St	B - Residential	1	55	48	-7
16 Lark St	B - Residential	5	62	57	-5
36 Lark St	B - Residential	10	59	56	-3
52 Lark St	B - Residential	12	60	60	0
14 Linden Park	B - Residential	4	64	61	-3
26 Linden Park	B - Residential	5	64	62	-2
38 Linden Park	B - Residential	4	59	56	-3
44 Linden Park	B - Residential	2	55	52	-3
47 Linden Park	B - Residential	2	61	57	-4
51 Linden Park	B - Residential	1	69	65	-4
58 Linden Park	B - Residential	1	57	56	-1
59 Linden Park	B - Residential	2	66	64	-2
Linden Park Greenspace	C - Park	2	59	56	-3
MLK Park -01	C - Park	4	61	59	-2
MLK Park -02	C - Park	4	60	59	-1
MLK Park -03	C - Park	4	51	50	-1
MLK Park -04	C - Park	4	62	57	-5
MLK Park -05	C - Park	4	65	60	-5
MLK Park -06	C - Park	6	57	54	-3
MLK Park -07	C - Park	8	51	49	-2
MLK Park -08	C - Park	8	59	57	-2
6 N Parade Ave	B - Residential	7	50	49	-1
523 Northampton St	C - Place of Worship	6	52	49	-3
656 Northampton St	B - Residential	1	54	50	-4
662 Northampton St	B - Residential	4	61	59	-2

Table: Noise Summary - Model Results

PIN 5512.52 - NYS Route 33, Kensington Expressway Project, City of Buffalo, Erie County, New York

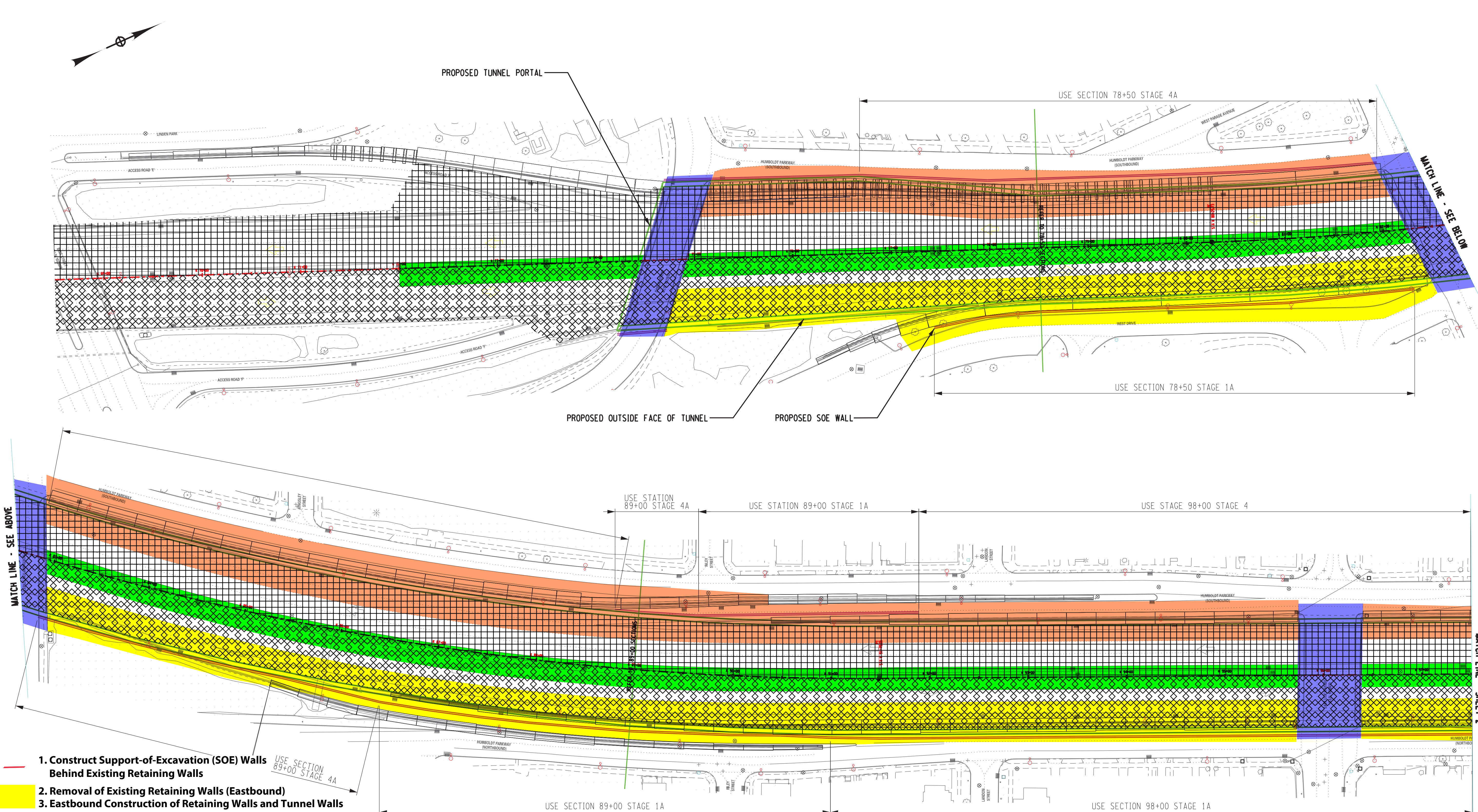
Address	Land Use	Receptors (Equivalent Number of Residences)	2047 No-Build Alternative (dB(A))	2047 Build Alternative (dB(A))	Change from No-Build to Build (dB(A))
479 Northland Ave	B - Residential	2	55	55	0
397 Northland Ave	C - Playground	10	60	61	1
410 Northland Ave	B - Residential	5	64	64	0
463 Northland Ave	B - Residential	4	64	64	0
466 Northland Ave	B - Residential	5	62	63	1
468 Northland Ave	B - Residential	3	62	62	0
2 Norway Park	B - Residential	4	67	66	-1
19 Norway Park	B - Residential	12	53	52	-1
49 Norway Park	B - Residential	14	49	50	1
Norway Park Greenspace	C - Park	2	59	57	-2
21 Portage St	B - Residential	6	55	51	-4
10 Regina Pl	B - Residential	4	58	58	0
18 Regina Pl	B - Residential	4	56	56	0
34 Regina Pl	B - Residential	2	55	55	0
578 Riley St	B - Residential	3	55	55	0
639 Riley St	B - Residential	4	58	53	-5
640 Riley St	B - Residential	4	57	59	2
622 Sherman St	B - Residential	4	55	55	0
633 Sherman St	B - Residential	2	57	57	0
702 Sherman St	B - Residential	1	56	54	-2
704 Sherman St	B - Residential	5	55	53	-2
708 Sherman St	B - Residential	6	58	57	-1
719 Sherman St	B - Residential	1	67	66	-1
74 W Parade Ave	B - Residential	6	64	56	-8
80 W Parade Ave	B - Residential	3	56	51	-5
96 W Parade Ave	B - Residential	4	60	55	-5
112 W Parade Ave	B - Residential	6	58	58	0
W Parade Greenspace	C - Park	1	64	58	-6
224 Winslow Ave	B - Residential	8	53	54	1
281 Winslow Ave	B - Residential	5	55	50	-5
282 Winslow Ave	B - Residential	2	55	55	0
288 Winslow Ave	B - Residential	1	55	51	-4
19 Woeppel St	B - Residential	3	57	55	-2
544 Woodlawn Ave	B - Residential	2	58	56	-2
549 Woodlawn Ave	B - Residential	7	56	53	-3
554 Woodlawn Ave	B - Residential	2	60	57	-3
605 Woodlawn Ave	B - Residential	5	60	55	-5
608 Woodlawn Ave	B - Residential	7	56	55	-1
Tunnel Surface near Inter Park	C - Park	1	Inactive	63	Inactive
Tunnel Surface near Woodlawn	C - Park	1	Inactive	60	Inactive
Tunnel Surface near Glenwood	C - Park	1	Inactive	58	Inactive
Tunnel Surface near Landon	C - Park	1	Inactive	60	Inactive
Tunnel Surface near Girard	C - Park	1	Inactive	57	Inactive

Notes:

- Noise level results are presented in dB(A) Leq.
- Inactive = Receiver is not present given the geometric design under this alternative; therefore, no results were calculated at this receiver under this alternative.
- Noise levels indicated above are truncated to a whole number.
- Perceptible noise level decreases greater than 3 dB(A) are highlighted in green.

ATTACHMENT D

Construction Scenario Areas



1. Construct Support-of-Excavation (SOE) Walls Behind Existing Retaining Walls

2. Removal of Existing Retaining Walls (Eastbound)
3. Eastbound Construction of Retaining Walls and Tunnel Walls

4. Bridge Demolition (Removal)

5. Center Tunnel Wall Construction

6. Eastbound Soil Overburden Removal
7. Eastbound Rock Removal - Mechanical Means
8. Eastbound Rock Removal - Blasting

2. Westbound Removal of Existing Retaining Walls
9. Westbound Construction of Retaining Walls and Tunnel Walls

6. Westbound Soil Overburden Removal
7. Westbound Rock Removal - Mechanical Means
8. Westbound Rock Removal - Blasting

SCALE: 1" = 100'

AS-BUILT REVISIONS DESCRIPTION OF ALTERATIONS:	COUNTY: REGION:	PIN	BRIDGES	CULVERTS	ALL DIMENSIONS IN ft UNLESS OTHERWISE NOTED	CONTRACT NUMBER
					Figure 4a - Construction Scenario Areas	DRAWING NO. SHEET NO. 1 OF 2

IT IS A VIOLATION OF LAW FOR ANY PERSON, UNLESS THEY ARE ACTING UNDER THE DIRECTION OF A LICENSED PROFESSIONAL ENGINEER, ARCHITECT, LANDSCAPE ARCHITECT, OR LAND SURVEYOR, TO ALTER AN ITEM IN ANY WAY. IF AN ITEM BEARING THE STAMP OF A LICENSED PROFESSIONAL IS ALTERED, THE ALTERING ENGINEER, ARCHITECT, LANDSCAPE ARCHITECT, OR LAND SURVEYOR SHALL STAMP THE DOCUMENT AND INCLUDE THE NOTATION "ALTERED BY" FOLLOWED BY THEIR SIGNATURE, THE DATE OF SUCH ALTERATION, AND A SPECIFIC DESCRIPTION OF THE ALTERATION.

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JOB MANAGER
DESIGN SUPERVISOR

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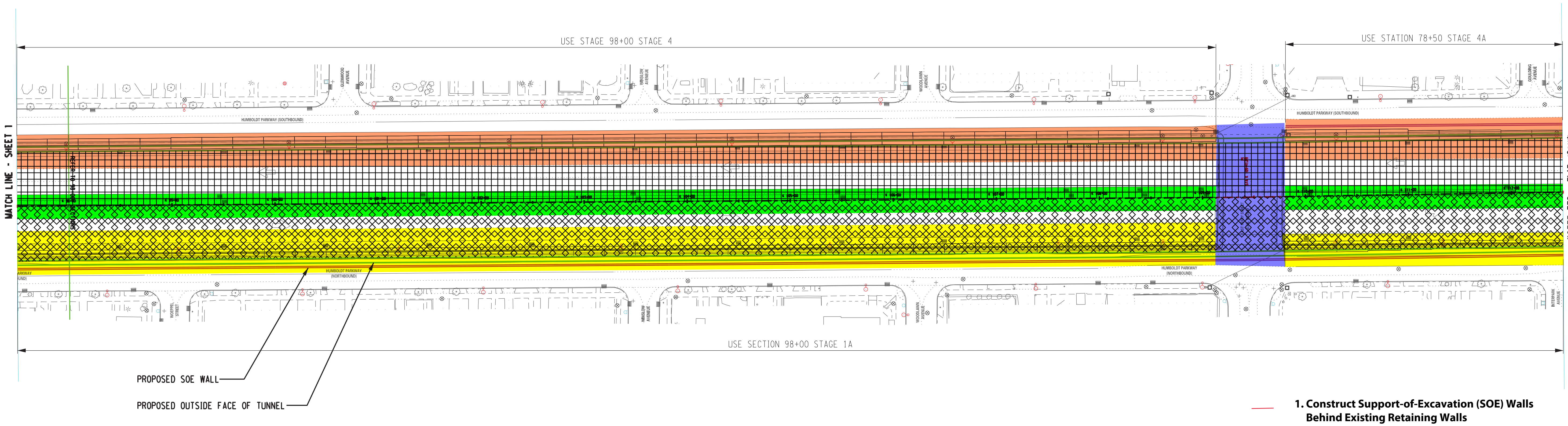

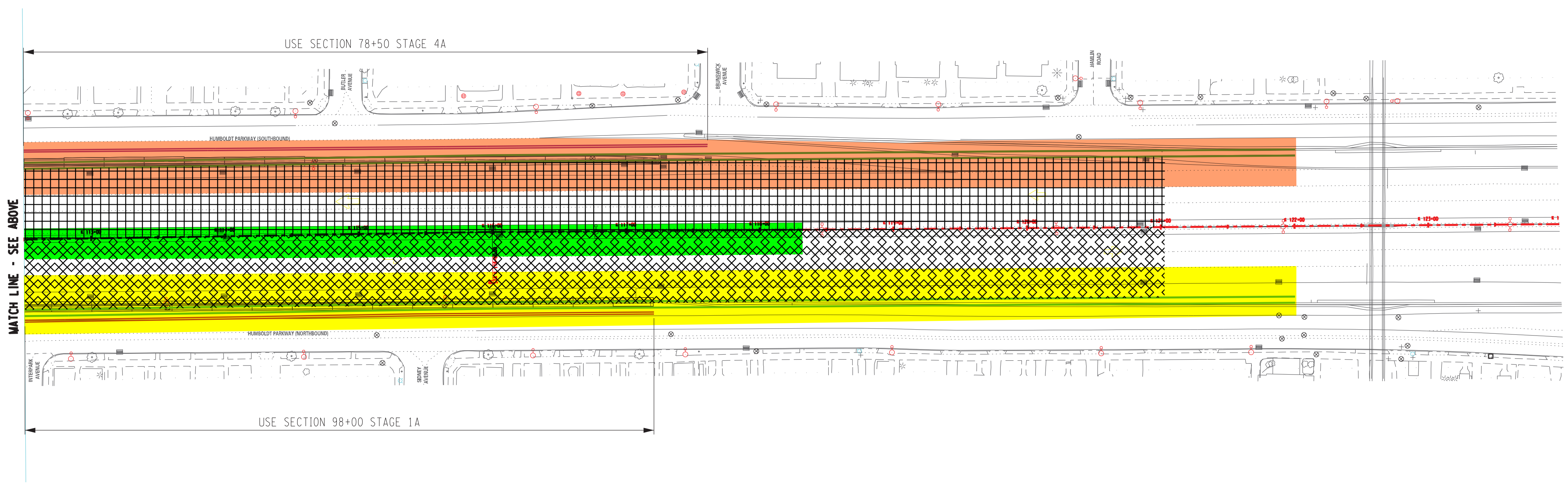

1. Construct Support-of-Excavation (SOE) Walls Behind Existing Retaining Walls
2. Removal of Existing Retaining Walls (Eastbound)
3. Eastbound Construction of Retaining Walls and Tunnel Walls
4. Bridge Demolition (Removal)
5. Center Tunnel Wall Construction
6. Eastbound Soil Overburden Removal
7. Eastbound Rock Removal - Mechanical Means
8. Eastbound Rock Removal - Blasting
2. Removal of Existing Retaining Walls (Westbound)
9. Westbound Construction of Retaining Walls and Tunnel Walls
6. Westbound Soil Overburden Removal
7. Westbound Rock Removal - Mechanical Means
8. Westbound Rock Removal - Blasting

SCALE: 1" = 100'

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AS-BUILT REVISIONS DESCRIPTION OF ALTERATIONS:	COUNTY: REGION:	PIN	BRIDGES	CULVERTS	ALL DIMENSIONS IN ft UNLESS OTHERWISE NOTED	CONTRACT NUMBER
					Figure 4b - Construction Scenario Areas	DRAWING NO. SHEET NO. 2 OF 2

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